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U.S. Army Environmental Center

FORT DEVENS
FEASIBILITY STUDY (FS)
FOR GROUP 1A SITES

FINAL
DATA GAP ACTIVITIES WORK PLAN
DATA ITEM A004

CONTRACT DAAA15-91-D-0008

U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

MARCH 1993

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CONTRACT DAAA15-91-D-0008
DELIVERY ORDER NUMBER 0004

Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Prepared by:

ABB Environmental Services, Inc.
Portland, Maine
Project No. 07005-01

MARCH 1993

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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

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LIST OF FIGURES

FORT DEVENS FEASIBILITY STUDY (FS) FOR GROUP 1A SITES
FINAL
DATA GAP ACTIVITIES WORK PLAN

LIST OF TABLES

1.0 PROJECT DESCRIPTION/RATIONALE

1.1 PURPOSE

At the direction of the U.S. Army Environmental Center (AEC), formerly the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), ABB Environmental Services, Inc. (ABB-ES) will conduct supplemental field investigations under USATHAMA Contract DAAA15-91-D-0008, Delivery Order 0004, at the Shepley's Hill Landfill and Cold Spring Brook Landfill at Fort Devens, Massachusetts (Figure 1). These areas were identified for investigation in the Fort Devens Master Environmental Plan (MEP) as the Group 1A sites, and are subject to a Federal Facility Agreement between the U.S. Department of the Army and the U.S. Environmental Protection Agency (USEPA). The Shepley's Hill Landfill contains Areas of Contamination (AOCs) 4, 5, and 18. The Cold Spring Brook Landfill contains AOC 40 (Biang, 1991).

On 21 September 1990, AEC assigned a delivery order to Ecology and Environment, Inc. (E&E) under USATHAMA Contract No. DAAA15-90-D-0012, to conduct Remedial Investigations (RIs) at Shepley's Hill Landfill and Cold Spring Brook Landfill. Previous investigations at both landfills indicated the need for further characterization at the site. The RIs for the Shepley's Hill and Cold Spring Brook landfills were designed to compile data needed to assess the type and location of hazardous materials at the landfills and the impact from these materials on the surrounding environment.

During initiation of the Feasibility Study (FS) to evaluate alternatives to remediate contamination at AOCs 4, 5, 18, and 40, the U.S. Army and its contractors identified several data gaps in the draft final RI report that affect preliminary technologies screening and development of remedial alternatives. Further field investigations are proposed to better establish the nature and extent of contamination at the Shepley's Hill and Cold Spring Brook landfills to support engineering evaluations and enable completion of an FS. In addition, an ecological survey is proposed to better evaluate ecological habitats and receptors at the two landfills. Comparisons of affected areas with reference areas and or regional databases will provide information regarding site-related effects.

SECTION 1

The background information on Shepley's Hill Landfill and Cold Spring Brook Landfill and the rationale and plans for proposed field investigations are set forth in this Work Plan.

This Work Plan was developed in accordance with provisions of the Massachusetts Contingency Plan (310 CMR 40.000), the Comprehensive Environmental Response, Compensation, and Liability Act, the corrective action provisions of the Hazardous and Solid Waste Amendments, and the Toxic Substances Control Act. The work will be performed in accordance with the provisions of the Federal Facility Agreement (USEPA and U.S. Army, 1991a & b), to enable completion of the FS.

Background information in this Work Plan for the four AOCs in Group 1A is based largely on information in the MEP, information in the draft final RI report, review of installation documents, observations during site visits, and interviews with installation personnel.

The remainder of this section provides a discussion of related project documents referenced in this Work Plan, a project description, a description of Fort Devens, and specific background information on the Shepley's Hill and Cold Spring Brook landfills.

Section 2.0 discusses field investigation tasks, including project planning, Data Quality Objectives (DQOs), specific field tasks, the proposed analytical program, Quality Assurance/Quality Control (QA/QC), data management, and data evaluation.

Site-specific background, activities, and conditions, as well as the rationale and plans for investigations at the Shepley's Hill and Cold Spring Brook landfills are presented in Section 3.0.

Section 4.0 discusses tasks required to complete an ecological survey at the landfills. Project organization and personnel requirements are described in Section 5.0, and a project schedule is provided in Section 6.0.

1.2 RELATED PROJECT DOCUMENTS

The Project Operations Plan (POP) (ABB-ES, 1992a), referenced in this Work Plan, defines responsibilities and authorities for data quality, and prescribes requirements for confirming that field exploration activities undertaken by ABB-ES at Fort Devens are planned and executed in a manner consistent with AEC QA program objectives. The POP includes specific elements of a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HASP).

The POP provides guidance and specifications so that:

- samples are obtained under controlled conditions using appropriate and documented procedures;
- samples are identified uniquely, and controlled through sample tracking systems and chain-of-custody (COC) protocols;
- field determinations and laboratory analytical results are of known quality and are valid, consistent, and compatible with the AEC chemical database through the use of certified methods, preventive maintenance, calibration and analytical protocols, QC measurements, review, correction of out-of-control situations, and audits;
- calculations and evaluations are accurate, appropriate, and consistent throughout the project;
- generated data are validated and their use in calculations is documented;
- safety is maintained by requiring that health and safety staff are included in the project organization; and
- records are retained as documentary evidence of the quality of samples, applied process, equipment, and results.

The requirements of the POP apply to all ABB-ES and subcontractor activities related to the collection of environmental measurements at Fort Devens. The

POP adheres to the requirements and guidelines contained in the AEC *Quality Assurance Program* (USATHAMA, 1990) for collection and analysis of samples and the AEC *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports* (USATHAMA, 1987) for installation of borings and monitoring wells, and land survey location. In addition, the POP meets guidelines of AEC COC procedures. Organizational responsibilities and interactions extending to all quality-related controls and activities are outlined in Section 2.0 of the POP.

The HASP is included in Appendix A of the POP, and complies with EM 385-1-1, AMC-R-385-100, and Fort Devens safety requirements, as well as Occupational Safety and Health Administration Regulations 29 CFR 1910.120. The HASP references appropriate information contained in previous investigation documents from Fort Devens.

The POP will be amended to include specific sampling and analysis procedures that are new to this Work Plan.

1.3 PROJECT DESCRIPTION

Objectives of the proposed field investigations at the Shepley's Hill and Cold Spring Brook landfills are to more clearly establish the nature and extent of contamination in groundwater, surface water, and sediments; to better define physical site characteristics in support of engineering evaluations; and to obtain data required to complete a detailed ecological risk assessment.

Work Plan investigations will, at a minimum, include the following basic elements:

- geophysical survey
- monitoring well installation/groundwater sampling
- surface water/sediment sampling
- water level measurements
- geotechnical laboratory testing

- chemical analysis
- horizontal and vertical survey
- site characterization
- ecological characterization and sampling

Samples from various environmental media will be collected during the field program, including groundwater, surface water, and sediment. Analyses for a variety of inorganic and organic chemicals have been scheduled for these samples. Analyses include testing for:

- volatile organic compounds (VOCs)
- semivolatile organic compounds (SVOCs)
- pesticides and polychlorinated biphenyls (PCBs)
- explosives
- total and dissolved metals
- Toxicity Characteristic Leaching Procedure (TCLP) for specific elements
- total organic carbon (TOC)
- water quality parameters such as pH, alkalinity, specific conductance, total suspended solids (TSS), and total dissolved solids (TDS)

1.4 ENVIRONMENTAL SETTING

Fort Devens, located in the towns of Ayer, Harvard, Lancaster, and Shirley, in central Massachusetts, has operated as a military facility on and off since 1917 and has functioned as a training camp, induction center, and demobilization

center. Fort Devens currently supports the USA Intelligence School, Ft. Devens; U.S. Army Reserves; Massachusetts National Guard; Reserve Officer Training Program; active Army units; and Cutler Army Hospital.

Fort Devens is located approximately 35 miles northwest of Boston, in a transitional area between the coastal lowland and central upland regions of Massachusetts. It occupies approximately 9,400 acres (14.7 square miles) and is partitioned into the North Post, the Main Post, and the South Post. The terrain is characterized by rolling hills and the area is drained by the sluggish, north-flowing Nashua River. The highest ground elevations are on the order of 450 feet relative to the National Geodetic Vertical Datum, on top of some hills on site; and the lowest on-site elevation is approximately 210 feet, where the Nashua River exits the North Post near Route 2A. There are no major industrial operations at Fort Devens. Several small operations, including photographic processing and vehicle, aircraft, and small engine maintenance, produce hazardous wastes.

Most of the installation is covered by stratified sand, gravel, and cobble-gravel units, possibly overlying discontinuous till. The landforms and surficial geologic deposits of much of the area are products of glacial meltwater deposition in lake and ice-contact environments during the final retreat of Pleistocene glaciers. These meltwater (i.e., outwash) deposits are associated with various successive stages of glacial Lake Nashua.

Bedrock at the installation is inferred to consist of high-grade metasediments and granite-granodiorite intrusives of Ordovician-Silurian age. The area is structurally complex, with the principal structural trend oriented northeast-southwest. Major faults and cross-faults are located in the area, and rock exposed in outcrops on site (e.g., Shepley's Hill) is moderately to highly fractured.

The climate in the Fort Devens area is characterized by long cold winters and short, moderately warm summers, with a mean annual temperature of 50°F. The area receives approximately 39 inches of rain per year, with an average annual snowfall of 65 inches.

The major surface water body at the site is Nashua River, which meanders from south to north across the site. Several small ponds and one lake are within the installation boundaries.

Groundwater in the surficial aquifer at the facility has been assigned to Class I under Commonwealth of Massachusetts regulations. Class I consists of groundwaters "found in the saturated zone of unconsolidated deposits or consolidated rock and bedrock and are designated as a source of potable water supply." Three large potable water supply wells and a well field are located on the base. Laboratory analysis of water samples from the wells has shown that groundwater quality meets Massachusetts drinking water standards except for sodium.

1.5 STUDY AREA LOCATIONS AND BACKGROUND

The following subsections provide site and waste descriptions for the Shepley's Hill and Cold Spring Brook landfills.

1.5.1 Shepley's Hill Landfill

Shepley's Hill Landfill is a relatively large facility, encompassing approximately 84 acres in the northeast corner of the Main Post at Fort Devens, close to the town of Ayer. Surface water runoff from the landfill drains north and east into Plow Shop Pond and into a wooded wetland adjacent to Nonacoicus Brook north of the landfill, both of which drain into Nonacoicus Brook and ultimately to the Nashua River. Groundwater also follows the same general pattern of flow, discharging into Plow Shop Pond and into the wetland north of the landfill.

Plow Shop Pond is located outside the installation boundary to the northeast of the landfill and has a water surface elevation of 216 to 217 feet above mean sea level (AMSL). Plow Shop Pond is maintained by two small dams, one adjacent to the landfill in the northwest corner of the pond and the other at Moore's Lumberyard at the north end of the pond. Beyond the pond is the small town of Ayer (population 2,889, 1990 Census). East of the landfill and Plow Shop Pond is the Boston and Maine Railroad. The railroad's embankment separates Plow Shop Pond from Grove Pond, although they are connected by a culvert under the tracks.

The Shepley's Hill Landfill area includes three AOCs: AOC 4, the sanitary landfill incinerator; AOC 5, sanitary landfill No. 1, or Shepley's Hill Landfill; and AOC 18, the asbestos cell. The sanitary landfill incinerator (AOC 4) was located

near Cook Street within the area included in Phase I of the sanitary landfill closure (Figure 2). The incinerator burned household debris generated at Fort Devens; glass and incinerator ash were placed in the landfill. In 1967, the incinerator was demolished and placed in the landfill. In 1976, the building foundation was also removed and landfilled on site.

On AOC 5, the landfill proper, operations date back to 1917. A small portion of AOC 5 south of Plow Shop Pond (near wells SHL-3 and SHL-7) is the site of a former railroad roundhouse. This roundhouse was used between 1900 and 1935. Because of the age of the facility, any contaminants would probably be the result of coal and steam-era wastes. The landfill received about 6,500 tons per year of household and military refuse, and construction debris during its last few years of use.

Review of the surficial geology map of Ayer Quadrangle (Jahns, 1953) shows that, in the early 1940s, the active landfill consisted of approximately 5 acres off the end of Cook Road near what is now monitoring well SHL-1. The fill was elongated north-south along a preexisting small valley marked by at least two swamps (probably kettle holes) and lying between the bedrock outcrop of Shepley's Hill to the west and a flat-topped kame terrace with an elevation of 250 feet to the east, adjacent to Plow Shop Pond. Existing fill extending off the railroad embankment along the south shore of Plow Shop Pond is unrelated to Shepley's Hill Landfill although they later become contiguous. It is evident that during the landfill expansion, the preexisting valley was largely obliterated, as was much of the kame terrace, which was presumably used for cover material.

Background information indicates the landfill was formerly operated as an open-burning site. Reportedly, flammable fluids were also disposed of in the southern portion of the landfill.

During the last few years of use, the landfill operated using the modified trench method. There is evidence that trenches in the northwest portion have cut into previously used areas containing glass and spent shell casings. The glass dated from the mid-nineteenth century to as late as 1920. The total depth of the refuse is about 30 feet (DEH, 1985b).

Fort Devens has an operating permit from the Massachusetts Department of Environmental Protection (MADEP), and the landfill operates within its

requirements. In an effort to abate the potential for off-site contaminant migration, Fort Devens initiated the Fort Devens Sanitary Landfill Closure Plan in 1984, in accordance with Massachusetts regulations 310 CMR 19.00. The four-stage plan, written by Gale Engineering, was submitted to MADEP for review and approval. In 1985, the MADEP approved the closure plan. As shown in Figure 2, the landfill is being closed in phases. In Phase I, 50 acres were capped in October 1986; in Phase II, 15 acres were capped in November 1987; and in Phase III, 9.2 acres were capped in March 1989. In May 1989, Fort Devens presented a proposal to MADEP to extend the Phase IV closure date and received a "conceptual approval." In Phase IV, 10 acres were divided into two sections. As part of a corrective action, Phase IV A of the landfill was closed in 1991, and Phase IV B closure is scheduled for 1993. Fort Devens is coordinating the closure with Commonwealth authorities; it includes regrading, gas ventilation, membrane capping, and applying a final vegetative cover. Some of the areas adjacent to Plow Shop Pond lie within the 100-year floodplain. These areas were excavated according to the approved closure plan.

The landfill contains a permitted asbestos cell (AOC 18) that was used for disposal of asbestos construction debris from on-site activities. An estimated 6.6 tons were placed in Section A of the Phase IV area between March 1982 and November 1985. That area was closed in 1991. A new asbestos disposal location has been identified in the southeastern corner of the Phase IV cell. More topographical details, further descriptions of each AOC at Shepley's Hill Landfill, and details of the phased closure can be found in the draft final RI report (E&E, 1992a).

1.5.2 Cold Spring Brook Landfill

Cold Spring Brook Landfill (AOC 40) is smaller than 3 acres, and is located in the southeastern part of the Main Post. It extends for approximately 900 feet along Patton Road and out into the former wetland along Cold Spring Brook, now mostly submerged beneath Cold Spring Brook Pond. The pond, created by the raised inlet of the Patton Road culvert, has been in existence since at least 1970 as shown in aerial photographs from that period (Figure 3).

Cold Spring Brook Landfill is considered abandoned, and was identified in November 1987 when 14 55-gallon drums were discovered along the edge of Cold Spring Brook Pond. An identification number on the drums indicated that the

original contents had been antifreeze manufactured by Union Carbide and that the drums were 15 to 20 years old. Apparently, the drums had been painted yellow and reused (Hopkins, 1988). In March 1988, the drums were examined by a response team from Union Carbide, New Hampshire. Other wastes at the landfill include concrete slabs, wire, storage tanks, rebar, timber, and debris found at depths of between 10 and 20 feet (Hopkins, 1988).

The upper surface of the landfill is gently sloping and is about 250 to 260 feet AMSL in elevation. It is densely covered with small trees and scrub, the trees being predominantly pines. The edge of the landfill falls off abruptly to the wetland or to the pond with an average elevation drop of perhaps 10 to 20 feet.

Across Patton Road to the south is a flat area with little vegetation that appears to have been excavated for gravel and sand. There are no indications of fill material south of the road. Beyond the apparent excavation area, a low hill covered with trees rises abruptly to above 300 feet AMSL.

A depression, that drains west and south to Little Mirror Lake, is located beyond a small hillock west of the pond. Adjacent to this depression, south of Patton Road, is Patton Well, a water supply well for Fort Devens. This well is approximately 500 feet from the south end of the landfill and 600 to 800 feet from the edge of Cold Spring Brook Pond. The well is screened from 46 to 76 feet below ground surface and appears to tap the same aquifer as that monitored by the landfill wells. A magazine area lies west of the pond, and Cold Spring Brook originates as drainage from a wetland in the center of this area. The brook drains north to Grove Pond, passing through several palustrine forested or scrub/shrub wetlands before reaching it.

Apart from the upgradient magazine area and the Patton Well, the only active facility near the landfill is a store on Patton Road, known as Shoppette.

The U.S. Army Environmental Hygiene Agency (USAEHA) completed a hydrological investigation of AOC 40 in 1988. Locations of the eight wells installed by USAEHA are shown in Figure 3. The investigation showed that the landfill is located over glacial sand and gravel deposits in, or adjacent to, a former wetland. U.S. Geological Survey (USGS) information indicates that the area is underlain by swampy deposits of muck and peat with adjacent units of sand and gravel from kame deposits. Except for two borings, coarse or medium- to fine-

grained sand interspersed by fine to coarse gravel was the primary subsurface material. Two borings (CSB-4 and CSB-5) adjacent to a peat deposit contained organic matter with silt and sand or clay (Fox, 1988).

Quarterly monitoring of the water elevations and water quality in the wells has continued since their installation, although CSB-5 was damaged in 1991.

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2.0 FIELD INVESTIGATION TASKS

This section of the Work Plan describes the general tasks necessary to undertake and complete the scope of work, as set forth in Section 4.0. The tasks proceed from planning, through field and laboratory work, and data evaluation to report preparation.

Detailed discussions of relevant requirements, methods, and procedures are presented in this Work Plan and separately in the ABB-ES Fort Devens POP, which includes elements of the Field Sampling Plan (FSP), the Quality Assurance Project Plan (QAPjP) and the HASP. The POP contains the major elements of a FSP, in that program-specific procedures for investigation activities are described in detail as these activities are common to investigations that will be conducted at the installation. This POP will be a working document that will be revised if ABB-ES procedures change or health and safety issues must be addressed during implementation of activities during the performance of Delivery Order 0004. The purpose of the Work Plan is to provide an overview of the program and the activities, and specific procedures and requirements where necessary, that will be conducted at the Group 1A sites (i.e., Shepley's Hill and Cold Spring Brook landfills). Development of Applicable or Relevant and Appropriate Requirements (ARARs) and risk assessment will not be included. Development of ARARs and risk assessment are part of the ongoing RI/FS process.

2.1 PROJECT PLANS/MEETINGS AND SITE VISITS

The field investigation work begins with project planning, and planning continues throughout the project as adjustments are made in response to actual conditions. The initial planning document is this Work Plan, which describes the site-specific activities and tasks that will be conducted at the Group 1A sites.

The principal planning document is the POP, which incorporates the SAP and the HASP. The SAP includes the QAPjP and elements of the FSP except the detailed AOC-specific activities. The POP presents detailed descriptions and discussions of the following elements:

- Project Organization and Responsibilities
- QA Objectives for Measurement
- General Sampling Procedures
- Sample Handling and Custody Procedures
- Equipment Calibration and Preventive Maintenance
- Analytical Procedures
- Data Management
- Internal QC
- QA Activities
- Problem Prevention
- Data Assessment Procedures
- Corrective Actions
- Reports
- Site-Specific HASP

The POP will be amended to include additional analytical procedures and requirements, specific to the Group 1A sites.

ABB-ES will meet periodically on the site with AEC, Fort Devens personnel, the USEPA, the U.S. Fish and Wildlife Service, and the MADEP to confirm that investigations proceed on schedule and in accordance with project objectives.

The locations of all sampling points will be identified in cooperation with AEC and regulatory agencies during site visits that will precede field mobilization.

ABB-ES will support AEC and the installation in quarterly Technical Review Committee briefings.

2.2 DATA QUALITY OBJECTIVES

Establishing DQOs is necessary to establish the level of detail required for proposed field investigation activities. Data generated during the field and laboratory tasks will be used to better define the nature and extent of contamination and physical site characteristics at the Shepley's Hill and Cold Spring Brook landfills. These data will be used to assist in developing and evaluating remedial alternatives for the Group 1A sites. The levels of quality,

AEC Certification Classes, and DQOs for the project are specified in Volume I, Section 3.2 of the POP.

2.3 FIELD INVESTIGATIONS

Fieldwork will be conducted in accordance with the procedures specifically identified in Volume I, Section 4.0 of the POP, or this Work Plan. A key controlling document for the methods and procedures used in conducting the field investigations will be *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports* (USATHAMA, 1987). This document has been reviewed and its standard techniques have been included in the POP. Site-specific conditions, plans, and rationale are presented in Section 4.0 of this Work Plan. The tasks necessary to undertake and complete the field investigation program are described in the following subsections.

Table 1 explains and summarizes the alphanumeric systems to be used for designating sample locations (known as "site identifications") and for uniquely identifying field samples ("sample identifications") and field QC samples.

2.3.1 Mobilization

Following authorization to begin fieldwork, ABB-ES and its subcontractors will mobilize to Fort Devens and implement the proposed field investigations program.

Mobilization will consist of field personnel orientation and equipment mobilization and will take place before initiation of the field program. A field team orientation meeting will be held with ABB-ES personnel and subcontractors to familiarize on-site personnel with the site history, health and safety requirements, Fort Devens security requirements, and AEC field procedures. Equipment mobilization will include but not be limited to the transportation and setup of the following equipment:

- subcontractor drilling equipment and necessary materials and supplies
- health and safety and decontamination equipment

- groundwater, surface water, and sediment sampling equipment
- survey equipment

The field office, established for other task order investigations, is equipped with a radio communications base station and a telephone. Each sampling team will be provided with a mobile hand-held radio to facilitate on-site communications. The field office will also function as a central storage area for field equipment, supplies, and on-site files.

2.3.2 Utility Clearance

Before the installation of groundwater monitoring wells, ABB-ES will obtain maps and utility drawings from the installation to identify the approximate location of subsurface utilities.

2.3.3 Site-Specific Field Investigation Tasks

The plans and rationale for field investigations, including analytical requirements, are described in detail for the Group 1A sites in Section 4.0 of this Work Plan. Performing those investigations will involve combinations of the following tasks:

- macroinvertebrate survey
- fish sampling program
- fish tissue analysis
- functional wetland evaluation
- seismic geophysical survey
- landfill gas monitoring
- groundwater monitoring well installation
- well development/groundwater sampling
- water level measurements
- surveying
- surface water and sediment sampling

Sampling procedures will be performed in accordance with the procedures presented in Volume I, Section 4.0 of the POP or this Work Plan.

2.4 ANALYTICAL PROGRAM

The analytical program for the Group 1A sites is designed to confirm the presence and concentrations of contaminants that were detected in groundwater, surface water, and sediments at the Shepley's Hill and Cold Spring Brook landfills as presented in the draft final RI report (E&E, 1992a). Contaminants detected during RI activities included VOCs, SVOCs, pesticides, PCBs, explosives, and inorganic chemicals.

The proposed analytical program for the Group 1 A sites includes a Project Analyte List (PAL) VOCs, SVOCs, inorganics (metals, total and dissolved), pesticides and PCBs, and explosives, as well as TCLP metals, pH, specific conductance, alkalinity, TSS, TDS, and TOC. The PAL is presented in Appendix A of this Work Plan. Dissolved metal concentrations will be established by analysis of field-filtered (0.45 micron) samples for individual analytes.

DQOs for Fort Devens field investigation programs are discussed in Volume I, Section 3.2 of the POP. Specific USEPA levels of analytical data quality applicable to the analytical program of the Group 1A sites are as follows:

- VOCs, SVOCs, pesticides and PCBs, and total and dissolved inorganics (USEPA Level IV, Contract Laboratory Program Routine Analytical Service [CLP RAS])

- explosives, pH, alkalinity, TSS, TDS, TOC and TCLP metals (USEPA Level III)

Section 3.0 of this Work Plan discusses specific analyses for each medium at each landfill. Analyses for each medium are listed in Table 2. All data will be generated according to AEC guidelines, which is the same level of quality and documentation as USEPA Region 1 CLP protocol.

2.5 PHYSICAL PARAMETERS

Grain-size distribution will be established for all sediment samples from Plow Shop Pond and from Cold Spring Brook Pond. Grain-size distribution was established for shallow sediment samples collected during the RI; however, no

deep sediment samples were collected. The additional grain-size information will assist in the development and evaluation of remedial alternatives.

Grain-size distribution will be conducted using standard sieve analyses for soils coarser than 0.075 millimeters (mm). For soils finer than 0.075 mm, grain-size distribution will be established by hydrometer.

2.6 QUALITY ASSURANCE/QUALITY CONTROL

Environmental sampling and analysis will be conducted in accordance with requirements of the AEC QA Program (USATHAMA, 1990) and the POP. QC procedures established for ABB-ES' field activities include the use of calibration standards and blanks for pH, specific conductance, temperature, and photoionization meter measurements.

QA/QC samples to be submitted to the laboratory include duplicate samples, trip blanks, and equipment rinsate blanks. Duplicate samples will be collected from 5 percent of all samples collected from each medium for each parameter at each landfill. They will be analyzed for the same parameters as the sample that was duplicated. Trip blanks will be collected (one per shipment) and shipped with all coolers containing water samples to be analyzed for VOCs. These will provide a basis for assessing the potential for contamination of samples with VOCs during sample collection or shipment. Rinsate blank samples will be collected from sampling equipment to address the potential for cross-contamination. The rinsate blanks will be analyzed for PAL parameters, as appropriate. Five percent matrix spike and matrix spike duplicates will be analyzed to characterize matrix effects on the basis of one per method per matrix per site. Methods requiring surrogates will not require matrix spikes. Details of the collection procedures and frequency of the QC samples are provided in Volume I, Section 9.0 of the POP. Method blank samples will also be analyzed to maintain internal QA/QC at the laboratory.

Samples will be handled and conveyed to the subcontractor laboratory in accordance with specified COC procedures. Sample management procedures, including sample container preservation requirements, COC program protocol and records, analytical request forms, and sample tracking and shipping are described in Volume I, Section 5.0 of the POP. Independent data validation of 10 percent

of the data will be performed by ABB-ES as described in Volume I, Section 8.2 of the POP. ABB-ES will receive complete QA packages for all samples from the subcontractor laboratory and will independently review them.

While analyses are being conducted, the subcontractor laboratory QA Coordinator will provide the ABB-ES QA Supervisor with the documentation specified in Volume I, Section 7.3 of the POP. The subcontractor laboratory will supply copies of all corrective actions to ABB-ES for approval. Although the subcontractor laboratory controls laboratory operations, the ABB-ES QA Supervisor retains ultimate responsibility for data quality.

2.7 DATA MANAGEMENT

Data generated as part of these field investigations will be managed in accordance with applicable AEC data management procedures (discussed in Volume I, Section 8.0 of the POP). Data for this project will include geotechnical data from monitoring well installation, groundwater elevation data from all Shepley's Hill and Cold Spring Brook landfill monitoring wells, pond bottom depths, and the results of chemical analyses of groundwater, surface water, and sediment samples.

2.8 DATA EVALUATION

Two deliverables will be created, one to summarize field investigations, and one to summarize the ecological survey.

2.8.1 Field Investigations

ABB-ES will evaluate data generated from the field investigations to confirm whether they meet specified DQOs. Evaluation of the data for each site will be the basis for establishing the nature and extent of contamination at the Shepley's Hill and Cold Spring Brook landfills, and confirming whether data gaps have been adequately filled. Completed field investigations and resulting data will be documented in an RI Addendum Report. Field data will be appended to this report, which will be used to assist in writing the FS.

2.8.2 Ecological Survey

An ABB-ES technical memorandum summarizing the Ecological Survey will be submitted. This memorandum will discuss the Wetland Evaluation Technique (WET) functional evaluation of wetlands at or associated with the Cold Spring Brook and Shepley's Hill landfills; macroinvertebrate study conducted in wetlands at or associated with the Cold Spring Brook and Shepley's Hill landfills; and the fish tissue sampling and analysis program conducted at Plow Shop Pond and Cold Spring Brook Pond.

The technical memorandum will not analyze all data collected in the ecological field program. Depending on the final scope of work, any appropriate raw, partially summarized, or fully summarized data may be included with the technical memorandum. Certain aspects of the field program project summary report(s) will be conducted by ABB-ES or another qualified environmental professional(s). If appropriate, the results of these studies will be discussed with regard to the study objectives and ecological risk assessment conclusions.

3.0 FIELD INVESTIGATIONS - GROUP 1A SITES

This Work Plan describes field investigations to be completed at the Shepley's Hill and Cold Spring Brook landfills at Fort Devens, Massachusetts. Investigations will be completed for the following media:

- groundwater
- surface water
- pond sediments
- surface soils

A brief summary of available data is presented for each site followed by a description of the rationale for the field investigations for each media. The procedures that will be followed for the field investigation activities are described in detail in Volume I, Section 4.0 of the POP or in the following subsections.

3.1 SHEPLEY'S HILL LANDFILL BACKGROUND AND CONDITIONS

Shepley's Hill Landfill occupies approximately 84 acres on the northeast side of the Main Post at Fort Devens. The landfill has been capped according to Massachusetts regulations (310 CMR 19.00) and final closure activities are scheduled for 1993. The southwestern portion of the landfill was the last to close and received approximately 6,500 tons per year of household and military refuse and construction debris. Wastes potentially disposed of in the landfill include incinerator ash (from burning household debris), glass, spent shell casings, and asbestos. Reportedly, flammable fluids were also disposed of in the southern portion of the landfill.

Plow Shop Pond is located outside the installation boundary east of Shepley's Hill Landfill. The landfill drains north and east into Plow Shop Pond and into a hardwood wetland north of the landfill, both of which drain into Nonacoicus Brook, a tributary of the Nashua River. Groundwater also follows the same general flow pattern, discharging into Plow Shop Pond and into the wetland north of the landfill. Grove Pond is east of Plow Shop Pond. The two ponds are separated by a Boston and Maine Railroad embankment, but are connected by a culvert under the railroad. Wells adjacent to Grove Pond are pumped by the

Town of Ayer and Fort Devens to supply drinking water, and probably induce recharge from Grove Pond.

3.1.1 Rationale and Plans for Groundwater Investigations

Groundwater samples collected for metals analysis as a part of remedial investigations were unfiltered in accordance with USEPA guidelines (E&E, 1992a). This complicated the interpretation of the results, because many samples may have contained suspended particulates that elevated the reported concentrations of metals. In addition, questions remain concerning groundwater flow at Shepley's Hill Landfill.

To obtain further information on the vertical component of groundwater flow, groundwater quality, and potential contaminant migration routes, five additional monitoring wells are proposed at Shepley's Hill Landfill. These will consist of a water table well, SHM-93-24A, located adjacent to existing well SHL-24; a water table well, SHM-93-01A, located about 250 feet west of SHL-10; a deep overburden well, SHM-93-18B, located adjacent to existing well SHL-18; a bedrock well, SHM-93-10C, located adjacent to existing well SHL-10; and a bedrock well, SHM-93-22C, located adjacent to existing well SHL-22. In addition to the types of information listed above, the bedrock wells will provide data on bedrock fracturing.

Information to better define the nature and extent of contamination and to support the FS will be obtained by collecting additional groundwater samples for laboratory analysis. The first sampling round will involve collecting unfiltered samples from all existing and new wells at Shepley's Hill Landfill (Figure 4) and analyzing them for VOCs, pesticides and PCBs, explosives, total metals, TOC, alkalinity, TSS, TDS, pH, and specific conductance. Filtered samples from half the wells will be analyzed for dissolved metals. Wells showing the highest concentrations of arsenic, lead, chromium, and copper during RI sampling will have filtered samples collected (Table 2). Prior to sampling, all existing wells will be redeveloped in accordance with Volume I, Section 4.4.6 of the POP. A second round of unfiltered groundwater samples will be collected from the new monitoring wells and analyzed for the same parameters as in the first round. Filtered samples from half the new wells will be analyzed for dissolved metals.

Groundwater sampling procedures including purging and purgewater handling will be in accordance with Volume I, Section 4.5.2 in the POP. Table 7-1 in the POP lists AEC and USEPA analytical methods for each parameter proposed for analysis.

3.1.2 Rationale and Plans for Pond Sediment Investigations

The risk assessment contained in the draft final RI report identified metals in sediment as the predominant contributor to human health and ecological risks at Plow Shop Pond (E&E, 1992a). Figure 5 shows the location of sediment samples collected during the RI. The RI investigated only shallow sediments; however, additional information is needed to characterize the depth of sediment contamination. Further information is also needed concerning water depth in Plow Shop Pond, sediment grain size, the potential leaching characteristics of metals in pond sediment, and the relationship of contaminant concentrations to the organic carbon content of sediment. All this information is needed in the development of remedial alternatives.

The proposed sediment sampling focuses on the southwestern portion of the pond where the highest concentrations of landfill-generated contamination exist (E&E, 1992a). In addition, surface water/sediment pair samples will be collected from five locations in Grove Pond, for comparison with Plow Shop Pond samples.

Because little information is known about pond water depths and sediment thickness, a reconnaissance site visit is proposed to gather preliminary information on pond depth and sediment type to facilitate selection of appropriate equipment for sediment sampling. During the reconnaissance, water depths will be measured with a weighted tape measure from a small boat or rubber raft at several locations, and a solid narrow diameter steel rod will be pushed into the sediment to estimate sediment thickness. In addition, sediment cores will be collected to examine sediment stratification and to compare with sediment thickness estimated by the steel rod. Efforts will be made to collect sediment cores with a 2-inch-diameter polyvinyl chloride (PVC) pipe driven by a hammer or vibratory method into pond sediment. The PVC pipe will be driven down a maximum of 5 feet into the sediment. Water will be pumped out with an ISCO pump, the top of the PVC tube will be capped with an expandable plug, and the sediment core will be retrieved. The sediment core will be extruded and examined visually to estimate the thickness and physical characteristics of the sediment. Visual observations will

be made, especially in the southwestern area of the pond, to characterize the extent of shallow areas.

Following the reconnaissance site visit, vibratory coring techniques will be used to collect sediment cores from 25 sampling points in Plow Shop Pond as shown on Figure 6. Five shallow (0-to-6 inch) sediment sampling locations will be established in Grove Pond to allow comparison of Grove Pond contamination with contamination in Plow Shop Pond. Sampling locations will be field surveyed using an electronic distance meter (EDM), and specific stable references will be recorded. Each sampling location will be temporarily marked with a buoy.

The objective of sediment sampling in Plow Shop Pond is to characterize the sediment surface, and the bottom of the sediment layer to a maximum of 5 feet. A maximum of three sediment samples will be collected at each location. For purposes of these investigations, the sediment layer is defined as the soft fine-grained organic material that occurs above the first granular layer.

To obtain sediment samples with depth, a 4-inch diameter, 5-foot long core will be collected from each sampling location. The core will be collected with a 4-inch aluminum tube with a polyethylene liner driven by a hammer or other vibratory technology into pond sediments. The sediment will be extruded and examined to estimate its thickness and physical characteristics. Other technologies may be used to obtain the sediment samples, if appropriate, based on reconnaissance observations.

At each sampling location, a surface sediment sample will be collected from the 0-to-6 inch interval of the core. A second sediment sample will be collected from the driven corer at the bottom of the sediment layer. This sample will be obtained at a minimum 1-foot depth and maximum 5-foot depth. If sediment recovery is deeper than 3 feet, a third sediment sample will be collected from a depth midway between the sediment surface and the bottom of the sediment layer.

In addition, at five sampling locations, discrete samples will be collected from the sand below the sediment layer, down to 5 feet if available.

All sediment and sand samples collected from the Plow Shop and Grove ponds will be analyzed for total metals, pesticides and PCBs, TOC, grain-size

distribution, and percentage solids. Sediment samples from Grove Pond also will be analyzed for VOCs and SVOCs. Eight of the sediment samples from Plow Shop Pond (see Figure 6) will be analyzed for TCLP metals to evaluate the potential for metals to leach from dredged sediment, and to aid in the development of remedial alternatives. Surface water samples from Grove Pond will be analyzed for VOCs, SVOCs, pesticides and PCBs, total metals, TOC, alkalinity, TSS, TDS, pH, and specific conductance.

Field observations will be recorded in a field logbook or on a sample data sheet. Observations will include the physical description of sediment, and the depth interval that was sampled. All sediment sampling devices will be cleaned and decontaminated between sample locations, in accordance with Volume I, Section 4.3 of the POP.

3.1.3 Rationale and Plans for Nonacoicus Brook Wetland Investigations

Two RI sampling locations in the Nonacoicus Brook wetland north of Plow Shop Pond showed elevated concentrations of metals in surface water and low concentrations of metals in sediment. To better characterize the nature and extent of contamination in the Nonacoicus Brook wetland, surface water and sediment sampling are proposed as a part of this Work Plan (see Figure 6).

Before sample collection, visual observations will be made within the wetland area to locate seeps or surface expressions of groundwater not directly connected to the brook. Up to five locations will be chosen to sample surface water and soil/sediment. If there is standing or flowing water in a seep, a surface water sample will be collected. Surface water samples will be analyzed for VOCs, pesticides and PCBs, explosives, total and dissolved metals, pH, alkalinity, specific conductance, TOC, TSS, and TDS to evaluate whether the wetland is a discharge area for contaminated groundwater. Surface water samples will be collected in accordance with Volume I, Section 4.5.2 of the POP.

A maximum of three discrete sediment samples will be collected with depth at each of the five wetland locations. As discussed in Subsection 3.1.2 of this Work Plan, a discrete surface (0-to-6 inch) sediment sample will be collected at each location in accordance with Volume I, Section 4.5.3 of the POP. A hand or power auger or other appropriate equipment will be used to collect sediments to a depth of 5 feet from each location. As with Plow Shop Pond sediments, a sample

will be collected from the bottom of the sediment layer and at a midpoint, as applicable, based on the criteria in Subsection 3.1.2 of this plan.

Sediment samples will be analyzed for VOCs, pesticides and PCBs, explosives, total metals, TOC, grain-size distribution and percent solids. Ten percent of the samples will be analyzed for TCLP metals (see Table 2). Data from these analyses will aid in evaluating the need for remedial actions and in the development of remedial alternatives.

3.1.4 Leachate Seep Investigations

A site reconnaissance will be conducted along the perimeter of the landfill to locate potential leachate seeps not identified during the RI. If identified, up to three surface water/sediment pairs will be collected and analyzed for the same target analytes as the wetland surface water and sediment samples.

3.1.5 Seismic Geophysical Survey

A seismic geophysical survey is proposed to obtain additional information on the inferred bedrock trough beneath Shepley's Hill Landfill. Information on the bedrock trough will be considered during the evaluation of groundwater flow and may be useful in placing additional groundwater monitoring wells. Seismic survey techniques will also be tried within the bounds of the landfill to better define the extent and depth of fill materials; however, air pockets within landfill materials may prevent obtaining useful results.

The seismic survey will involve placement of dynamite charges (anticipated 0.5 pound maximum) in 3.5-to-4-foot-deep bar-driven holes. Four-hundred-foot seismic spreads with geophones spaced at 20-foot intervals will be used to monitor seismic response. At a minimum, energy generation points will be located at the end of each seismic spread. Data interpretation will be by USGS SIPT as well as manual methods. Figure 4 shows the proposed seismic lines.

3.1.6 Landfill Gas Monitoring

A landfill gas monitoring program will be implemented to assess whether landfill gas may be migrating off site. The program will consist of collecting landfill gas samples from four existing gas vents installed through the landfill cover and

samples from 16 soil gas probes located along the perimeter of the landfill. The gas probe samples will be collected from an approximate depth of 10 feet below ground surface or half the depth to the interpreted groundwater table, whichever is less.

Gas samples will be field analyzed for methane and selected PAL VOCs using a gas chromatograph with concentration trap and an electron capture detector/ flame ionization detector (ECD/FID).

In addition to methane, the planned soil gas analytes include all VOCs confirmed in RI groundwater samples and listed below:

- methane
- benzene
- chlorobenzene
- chloroethane
- chloroethene (vinyl chloride)
- chloroform
- 1,1-dichloroethane
- 1,2-dichloroethane
- methylene chloride
- 1,1,2,2-tetrachloroethane
- tetrachloroethylene
- trichloroethylene

The analytical method will be USEPA Method 8010/8015 modified for trap concentration of vapors. The expected detection limit for methane is 1 to 5 parts per million (volume basis). The expected detection limit for the listed PAL compounds using the proposed analytical approach is 1 part per billion (volume basis). Approximate gas sampling locations are shown on Figure 4.

3.1.7 Railroad Roundhouse

Environmental samples will be collected at four locations at the site of the former railroad roundhouse adjacent to Shepley's Hill Landfill. The rationale for the samples are described below and the locations are shown on Figure 6.

- Collection of a shallow (0-to-6-inch) sediment sample from coal-ash deposits in Plow Shop Pond adjacent to the roundhouse area. These samples will evaluate the presence of contaminants in Plow Shop Pond sediments immediately adjacent to the roundhouse area.

- Collection of one soil sample from a shallow (6-to-12-inch) excavation in ash deposits adjacent to Plow Shop Pond. This sample should be from the area between the old foundations and the pond. Analytical results from this sample will help in assessing the potential for the ash to be a continuing source of contamination to Plow Shop Pond.

- Collection of one soil sample from a shallow (6-to-12-inch) excavation on the level area among the old foundation slabs. This sample will aid in assessing contamination in this area and the potential for soil in that area to be a source of contaminants in Plow Shop Pond.

- Collection of a soil sample from a shallow excavation adjacent to the five interconnected 750-gallon tanks located at the southeastern edge of the roundhouse area, near the existing railyard. This sample will aid in evaluating whether this area is or has been a source of contaminants to Plow Shop Pond. A shallow test pit (12-to-18-inches deep) will be dug to see if there are any stained areas or contamination horizons from which to collect a sample.

The samples will be analyzed for the following parameters:

Sample Location	VOCs	SVOCs	Pests/ PCBs	Total Metals	TCLP (Metals)	TOC	% Moisture
Sediment 0-6"		X	X	X	X	X	X
Soil Location 1		X	X	X	X	X	X
Soil Location 2		X	X	X		X	X
Soil at Tanks	X	X	X	X		X	X

3.2 COLD SPRING BROOK LANDFILL BACKGROUND AND CONDITIONS

The Cold Spring Brook Landfill is an abandoned landfill, which became an area of concern in November 1987, when 14 55-gallon drums were discovered along Cold Spring Brook. Landfilling was reported to have begun at least 40 years earlier. Waste materials in the landfill include concrete slabs, asphalt pavement, wire, rebar, tanks, timber, and other construction debris. After the start of landfilling along Patton Road, the culverted outlet for Cold Spring Brook was raised to create a pond that now abuts parts of the landfill. Based on aerial photographs, this occurred before 1970.

In 1988, the drums were examined by a response team from Union Carbide (New Hampshire). An identification number on the drums indicated that the original contents was antifreeze manufactured by Union Carbide 15 to 20 years ago. Apparently the drums had been painted yellow and reused.

The risk assessment contained in the draft final RI report indicated that metals in groundwater and the combination of metals and pesticide residues in sediment resulted in human health and ecological risks exceeding target ranges and threshold values. In addition, relatively high polynuclear aromatic hydrocarbon (PAH) concentrations in one sediment sample were of concern.

3.2.1 Rationale and Plans for Sampling Groundwater

Two rounds of groundwater samples were collected from seven monitoring wells at the Cold Spring Brook Landfill during RI activities. As with the groundwater samples collected at Shepley's Hill Landfill, samples collected for metals analysis were unfiltered in accordance with USEPA guidelines (E&E, 1992a). To facilitate evaluation of the effect of suspended solids on metals concentrations, two additional rounds of samples will be collected from the monitoring wells at Cold Spring Brook Landfill.

Currently, seven functioning monitoring wells exist at Cold Spring Brook Landfill, as shown on Figure 3. CSB-5 is no longer a functioning well; it was damaged in 1991. As a part of this Work Plan, it is proposed that monitoring well CSB-5 be repaired, or abandoned if repair is not possible. An additional new well (CSB-93-01A) will be installed through landfilled material adjacent to existing well CSB-4 and screened in the sand and gravel aquifer. Monitoring well CSB-4

has a very low yield that prevents collection of adequate sample volume for all target analytes. In addition, its screened interval, in peaty material, is not representative of where a future residential well might be placed. A nested pair of monitoring wells, consisting of a water table well and a deep overburden well (CSM-93-02A and CSM-93-02B), will be located midway between existing well CSB-2 and Patton Well. Procedures for well installation and abandonment will be in accordance with Volume I, Section 4.4.6 of the POP.

Before the first round of groundwater sampling, all 11 wells (existing and new) will be developed in accordance with Volume I, Section 4.4.6 of the POP. Unfiltered samples will be analyzed for SVOCs, pesticides and PCBs, explosives, and total metals to obtain further data concerning their presence in groundwater, and for the following general groundwater quality parameters: TOC, pH, specific conductance, alkalinity, TSS, and TDS. Filtered samples will be collected from half the wells and analyzed for dissolved metals. A second round of samples will be collected from the newly installed wells and analyzed for the same parameters as in the first round. Filtered samples will be collected from half the wells and analyzed for total metals.

The Patton Well will be sampled for VOCs, SVOCs, pesticides and PCBs, explosives, PAL metals, and the general water quality parameters: TOC, pH, specific conductance, alkalinity, TSS, and TDS.

Groundwater sampling procedures include purging. Purge water handling will be in accordance with Volume I, Section 4.5.2 of the POP. Table 7-1 in the POP lists AEC and USEPA analytical methods for each parameter proposed for analysis.

3.2.2 Rationale and Plans for Pond Sediment Investigations

The draft RI report identified two locations within Cold Spring Brook Pond where sediment contamination appeared concentrated: at sample location SE-CSB-02 along the edge of the landfill, and at SE-CSB-09 near the outlet culvert (Figure 7).

To better define the nature and extent of this contamination, collection of additional sediment samples at 10 pond locations is proposed. This includes five locations on a sample grid near SE-CSB-09 at the outlet culvert, four locations

near the former sample location SE-CSB-02, and one sample from an intermediate location. The sample locations near SE-CSB-02 will be adjacent to the area where discarded drums have been identified. The sample locations near the outlet culvert will be near where high PAH concentrations were measured. Because there is little information available about the pond at Cold Spring Brook Landfill, a reconnaissance visit will be made to gather preliminary information as described in Subsection 3.1.2.

The sediment sampling locations will be field surveyed using an EDM and temporarily marked with buoys. These sample locations are shown in Figure 8. A maximum of three sediment samples will be collected from each sampling location. Using the same procedures outlined in Subsection 3.1.2 of this plan, a sediment sample from the sediment surface, a sediment sample from the bottom of the sediment layer in the core, and one sample from a midpoint in the core will be collected if applicable. Pond water depths also will be measured at each sediment sampling location as well as other locations to establish the bathymetry of the pond.

Along the face of Cold Spring Brook Landfill, up to three seep locations will be identified through visual observation prior to sampling. If there is standing or flowing water in a seep, a surface water sample will be collected in accordance with Volume I, Section 4.5.2 of the POP. Using the same procedures outlined in Subsection 3.1.3 of this plan, a maximum of three sediment samples will be collected at each seep location. These samples will help to establish the potential effect of landfill seeps on surface water and sediment contamination.

To enable comparison of pond sediment with sediment from an upgradient/ upstream location, three shallow sediment samples (0-to-6-inches deep) will be collected from the bed of the inlet channel to Cold Spring Brook Pond at the same locations as the shallow sediment samples. Surface water samples will be collected at the same locations as the shallow sediment samples to document upstream surface water quality. Surface water and shallow sediment samples will be collected in accordance with Volume I, Sections 4.5.2 and 4.5.3, respectively, of the POP. These sample locations are shown on Figure 8.

Surface water samples will be analyzed for SVOCs, pesticides and PCBs, explosives, total and dissolved metals, TOC, pH, specific conductance, alkalinity, TSS, and TDS. Sediment samples will be analyzed for SVOCs, pesticides and

PCBs, explosives, total metals, TOC, and percent solids to confirm previous analytical results. All sediment samples will be analyzed for grain-size distribution (including hydrometer), and 10 percent of the sediment samples from Cold Spring Brook Pond will be analyzed for TCLP metals to aid in the development and evaluation of remedial alternatives. Figure 8 shows the tentative location of these samples.

Field observations will be recorded in a field logbook or on a sample data sheet. Observations will include a physical description of sediment, and the depth interval that was sampled. All surface water and sediment sampling equipment will be cleaned and decontaminated between sampling locations in accordance with Volume I, Section 4.3 of the POP.

4.0 ECOLOGICAL SURVEY

Shepley's Hill Landfill is located south and west of Plow Shop Pond, a eutrophic pond that drains into Nonacoicus Brook and the Nashua River. Twenty-one vegetative cover types associated with the Shepley's Hill Landfill have been identified; 17 of these cover types encompass upland ecological communities and four cover types are indicative of wetland communities (E&E, 1992a). Plant and animal communities associated with the Shepley's Hill Landfill are described in the draft final RI report (E&E, 1992a).

The Baseline Ecological Risk Assessment at Shepley's Hill Landfill indicates that sediment contamination in Plow Shop Pond may pose a risk to aquatic and semi-aquatic organisms, including semi-aquatic vertebrates, fish, benthic invertebrates, and plants (E&E, 1992a). Estimated site-related risks are primarily a result of elevated arsenic concentrations in pond sediments; cadmium, barium, and manganese in sediments may also pose a risk at Plow Shop Pond.

Cold Spring Brook Landfill covers fewer than 3 acres and is located immediately adjacent and to the south of Cold Spring Brook Pond, an approximately 5-acre ponded aquatic system with numerous small islands and peninsulas. Cold Spring Brook originates a few hundred feet upstream of Cold Spring Brook Pond, and flows approximately 1.2 miles from Cold Spring Brook Pond to Bowers Brook, which drains into Grove Pond, and eventually into Plow Shop Pond and Nonacoicus Brook. Of the 24 vegetative cover types associated with the Cold Spring Brook Landfill, 15 are indicative of upland habitat, and nine are characteristic of wetland habitat (E&E, 1992a). Plant and animal communities, as well as vegetative cover types, associated with this landfill are described in the draft final RI report (E&E, 1992a).

The Baseline Ecological Risk Assessment at the Cold Spring Brook Landfill indicates that sediment contamination in Cold Spring Brook Pond may pose a risk to aquatic and semi-aquatic organisms, including semi-aquatic vertebrates, fish, and benthic invertebrates (E&E, 1992a). Estimated site-related risks are primarily a result of elevated arsenic concentrations in pond sediments. Low levels of the pesticides dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE), as well as PAH sediment contamination, may also pose an ecological risk at Cold Spring Brook Pond.

Although the Risk Assessment Approach Document and draft final RI report (E&E, 1992a and 1992b) provide detailed information regarding biota expected or anticipated to occur in various aquatic and wetland habitats at the two landfills, these reports contain limited site-specific information regarding actual use of aquatic and wetland habitats associated with either site by potential ecological receptors. No aquatic biota sampling was undertaken at either landfill by E&E.

Several state and federal environmental regulatory authorities reviewed the Risk Assessment Approach Document (E&E, 1992b) and requested additional information regarding use of wetland and aquatic habitats at the site by ecological receptors. Addressing some of these comments requires additional field effort at both landfill sites.

To better evaluate ecological habitat and receptors at the two landfill sites, additional habitat characterization is proposed. This characterization will provide a more detailed description of the aquatic habitats at the two landfill sites and of the biota associated with these habitats. Wetland and aquatic biotic communities will be characterized by the type and relative abundance of flora and fauna, and will be compared with either undisturbed reference areas and/or regional databases. The presence of any rare, threatened, or endangered species will be documented.

The following approach was developed to provide a wetland and aquatic ecological field investigation at the two landfills. Functional assessments of wetland communities will be conducted at both landfills to provide a rapid and reproducible function and value assessment. Macroinvertebrate studies at both landfills will be conducted to evaluate whether the benthic macroinvertebrate communities at either site are being (or have been) adversely affected by site-related contamination. A fish sampling program will be conducted to evaluate the fish communities associated with Plow Shop Pond and Cold Spring Brook Pond. Quantitative contaminant residue analyses of fish tissues will also occur.

A number of investigative approaches are proposed to document field conditions at these two Fort Devens landfills. Data collection and/or field observations will be recorded via a hand-held tape recorder, and/or recorded on field data sheets or in a bound field logbook. All tape recordings will be hand-transcribed into the bound field logbook following the field effort. Color photographs and 8-mm videotape will further document site conditions and the field investigation. These

visual media will provide a permanent record of site conditions at the time of the ecological field program. Standing Operating Procedures will be developed for any required methodologies.

Information gathered through the proposed ecological sampling and analysis program may provide information regarding food chain impacts from compounds that bioaccumulate or bioconcentrate in fish. The proposed ecological fieldwork will provide baseline information useful to evaluate existing impacts. Baseline information may also be used to evaluate the effects and effectiveness of any future remedial actions. Following evaluation of the information obtained from the ecological fieldwork, as well as assessment of potential human health and ecological risks, the Army will consider the need to conduct additional ecological studies. Such studies could include additional bioaccumulation studies or *in situ* testing and could take place as part of remedial design activities or as a requirement of the Record of Decision.

Certain aspects of all phases of this Work Plan, including but not limited to preparation for the field program, data review and analysis, and preparation and review of project summary report(s), will be conducted by ABB-ES or another qualified environmental professional(s).

4.1 PREPARATION AND INFORMATION REVIEW

Before conducting any fieldwork at Fort Devens, relevant information will be gathered from various public and private sector sources. The Fort Devens Natural Resource Office will be contacted and an introductory scoping session will be scheduled to review project goals and objectives. The draft final RI report (E&E, 1992a) and any previous risk assessment, ecological inventory work, or other appropriate studies conducted at either landfill, at Fort Devens, or in the region will be reviewed.

Various maps, charts, references, databases and photographs to be reviewed include, but are not limited to:

- USGS Maps
- U.S. Army maps

- U.S. Army aerial photographs
- local, state, regional, or academic fish and/or benthic macroinvertebrate databases
- aquatic toxicity database(s) (i.e., AQUIRE)
- phytotoxicity database(s) (i.e., PHYTOTOX)
- available maps indicating land use and/or fish and wildlife habitats
- Soil Surveys of Middlesex and Worcester Counties from the U.S. Department of Agriculture (USDA)
- National Wetlands Inventory maps from the U.S. Fish and Wildlife Service (USFWS)
- Flood Hazard Maps from the Federal Emergency Management Agency
- regional resource atlases (i.e., the Massachusetts Audubon Society Butterfly and Breeding Bird Atlases)
- stream gauge or lake level data
- Massachusetts Atlas of State-Listed Rare Wetlands Wildlife (MNHP, 1992).

The appropriate state and federal offices will be contacted to establish whether any fish species of commercial or recreational importance occur in Plow Shop Pond, or if any fish inventory studies have occurred in this pond or in similar regional waters. The Massachusetts Division of Fisheries and Wildlife will be consulted to determine whether established regional protocols exist for contaminant analysis of fish tissues. Similarly, regional and academic authorities will be contacted to see if any habitat, population, or community level fish or benthic invertebrate databases exist for central Massachusetts. Although the Commonwealth of Massachusetts does not maintain a general benthic invertebrate database, reference information may be obtained from historic programs (i.e., the Massachusetts Clean Lakes Program), or current programs (i.e., the University of

Massachusetts; Amherst, Museum of Zoology). Any relevant database information, as well as appropriate taxonomic keys and field guides, will be obtained and reviewed prior to commencement of the field investigation. Consultation with a project statistician will occur at this stage of the program to confirm that a properly designed field sampling program is undertaken. No field sampling of fish will occur at either landfill site until all appropriate local, state, and federal fish collection permits have been obtained.

4.2 RATIONALE AND PLAN FOR WETLAND FUNCTIONAL ASSESSMENT

Wetlands at the Shepley's Hill and Cold Spring Brook landfills will be functionally assessed through the use of the WET, which provides a reproducible and rapid method to assess wetland functions and values (Adamus, 1987). Wetland functions are defined as the biological, physical, and chemical characteristics of a wetland, whereas values are defined as those characteristics that are beneficial to society (Adamus, 1987). WET evaluates functions and values in terms of predictors, which are simple (or integrated) variables that may correlate with physical, chemical, or biological characteristics of a wetland and its surroundings.

WET functions and values are defined in terms of social significance, effectiveness, opportunity, and habitat suitability. According to the WET documentation (Adamus, 1987), an assessment of the social significance of a wetland evaluates the benefits a wetland provides to society in terms of special attributes, strategic location, and potential economic value. The WET effectiveness evaluation assesses the capability of a wetland to perform a function because of its physical, chemical, or biological characteristics. Opportunity assesses the ability of a wetland to perform its function to its maximum level of effectiveness, and habitat suitability assesses the quality of a wetland for waterfowl, freshwater fish, and other water-dependent biota.

The WET method (Adamus, 1987) provides a step-by-step task-oriented approach to functionally assess wetlands. This methodology includes obtaining, reviewing, and analyzing information sources before the field inspection. After conducting a site inspection and gathering site-specific information regarding the two wetlands associated with the Fort Devens landfills, the WET evaluation will be conducted through the use of the WET Program Version 2.1 software. The WET evaluation will be supplemented with a narrative prepared by a wetlands ecologist.

4.3 RATIONALE AND PLANS FOR MACROINVERTEBRATE SURVEY

Macroinvertebrate studies can provide a practical method to establish whether an aquatic system is supporting or is not supporting a macroinvertebrate community. When considered in conjunction with other ecological studies, macroinvertebrate studies can also assist in efforts to characterize the existence and extent of an impairment, identify source and causes of impairments, evaluate the effectiveness of remedial actions, and provide a baseline characterization of biotic components (Plafkin, 1989).

The macroinvertebrate community in Plow Shop Pond and in Cold Spring Brook Pond will be assessed via semiquantitative inventory techniques. An integrated assessment will be employed, incorporating habitat (e.g., physical structure and flow regime) and biological characteristics. Although the Rapid Bioassessment Protocol (RPB) is designed for stream systems (Plafkin, 1989), elements of the RPB method have been incorporated into the Plow Shop Pond and Cold Spring Brook Pond inventory approach.

4.3.1 Macroinvertebrate Inventory

A semiquantitative inventory of macroinvertebrates will be conducted at three stations in Plow Shop Pond and three stations at Cold Spring Brook Pond. If a suitable reference pond located at the Fort Devens South Post can be identified with input from USEPA, USFWS, and MADEP, three reference stations will be sampled. At each station, two duplicate macroinvertebrate samples from vegetation and two duplicate samples from sediment will be collected. All sampling will be standardized per unit area. Following taxonomic analysis, data will be measured with multivariate analytical procedures such as principal elements and clustering analysis, as well as diversity indices.

In siting the individual sampling stations, care will be taken so that the various stations are as comparable as possible with respect to any water movement, substrate composition, canopy coverage, and water depth (Davies, 1987). Tentative sampling locations are shown in Figures 6 and 8. Information regarding the physical attributes of the aquatic habitat (including nature of the substrate and vegetative characteristics) and water quality parameters (i.e., dissolved oxygen, temperature, pH, and conductivity) will be collected at each sampling station.

These observations will be recorded on field data sheets. Shallow sediment samples will be collocated with macroinvertebrate stations to document sediment characteristics; however, sampling may not be coincident.

The sediment samples will be analyzed for the following parameters:

ECOLOGICAL SAMPLE LOCATION

	PLOW SHOP POND	COLD SPRING BROOK POND	REFERENCE POND(S)
PAL VOCs			X
PAL SVOCs		X	X
Pesticides/PCBs	X	X	X
Explosives		X	X
PAL Inorganics	X	X	X
TOC	X	X	X
Grain Size Distribution	X	X	X
Percentage Solids	X	X	X

Additional surface water sampling beyond general water quality parameters is not planned as part of the macroinvertebrate study.

A qualitative habitat assessment will be conducted at each sampling station. Habitat parameters will be separated into three principal categories: primary, secondary, and tertiary, as they relate to aspects of the substrate and cover, bottom morphology, and riparian and bank structure, respectively (Plafkin, 1989). Habitat Assessment Field Data Sheets will be completed for each of these categories. Information recorded on data sheets will be qualitatively compared with the reference location(s) and the relative degree of habitat impairment will be assessed.

The locations of the sampling stations for the Fort Devens Data Gap activities will be based upon field inspection of the two landfills, and a review of analytical data for the sites. Consideration of ecologically important habitat variables, such

as water depth, macrophytic cover, and bottom characteristics, is necessary to confirm that the primary variable affecting macroinvertebrate community structure is related to contaminants in sediments. The reference locations will be selected to provide information regarding the unimpacted macroinvertebrate community in the waters adjacent to the two landfills. Sampling locations will be placed in a section of the water body that has been potentially affected. If significant degradation of the macroinvertebrate communities is detected as a result of this analysis, it is anticipated that some attenuation of these impacts will be observed in the furthest downstream (or, in the case of Plow Shop Pond, the furthest from the landfill source) station. Consequently, it may be possible to evaluate the potential extent of impact to the community following this sampling design.

Sampling of macroinvertebrates will be accomplished by use of either a dip net, dredge, kick net, or Surber sampler. The choice of sampling device will depend upon the substrate sampled. Depending upon prior consultation with regional authorities, references, and the project statistician, samples may be composited prior to processing.

If dip or kick nets are required to sample macroinvertebrates, D-frame aquatic dip nets (#30 mesh or ~575 microns) and/or modified Surber kicknets will be employed. Sweeps will be taken in as many different habitats as possible at a particular sampling location (e.g., under overhanging vegetation and logs, and along banks). An Ekman or Ponar dredge will be used to sample benthic organisms in areas with silt, muck, or sludge substrates. The dredge will be emptied into a sieve bucket and washed until the sample is condensed.

All biological samples will be processed according to the methodology specified in the RBP guidance manual (Plafkin, 1989). Collected material will be placed in an approximately 600-micron mesh wash bucket and rinsed before picking. A 100-organism subsample will be taken for those samples containing more than 100 organisms. This sample size is generally adequate to discriminate between impacted and non-impacted sites (Plafkin, 1989). To collect a sub-sample, the collected material will be evenly distributed in a gridded, light-colored sampling pan, and all organisms in randomly chosen grids will be picked until 100 organisms are collected. All macroinvertebrates collected for taxonomic analysis will be placed in sample jars and preserved in approximately 70 percent alcohol.

4.3.2 Sample Labeling/Shipping

Macroinvertebrate samples collected using either approach will be placed in sample jars containing 70 percent ethanol and forwarded to a qualified aquatic invertebrate taxonomist for identification. All samples will be labeled in the field immediately upon collection and the following information will be included on each label: date of sample retrieval; water body; location (town, county, state); station identification number; replicate number; type of preservative used; and sampling personnel.

Upon completion of the sampling activities, all preserved samples will be bubble-wrapped, placed in Ziplock bags, and sent to the taxonomist via overnight courier delivery.

4.3.3 Taxonomic Analysis

In the laboratory, each sample will be assigned a sample log number (which will be assigned to all items generated by the sample including, but not limited to, sample vials, slides, records, and count sheets). Log numbers will be simultaneously recorded in a master logbook in the sequence in which they were assigned (see Davies, 1987).

Davies (1987) provides instructions for sorting collected benthic macroinvertebrate samples. Macroinvertebrates will be identified to the genus or species level in all cases where practical. If possible, specimens of the following insect groups will be identified to the species level: Perlidae (Plecoptera), Baetidae, and *Stenonema* (Ephemeroptera). Species of chironomid midges (Diptera) will be identified from slide mounts of the cleared head capsules and body parts. Polyvinyl lactophenol or Berlese mounting medium will be used for preparation of the slides (Davies, 1987).

The contracted taxonomist will prepare and retain a voucher collection of identified taxa.

4.3.4 Data Analysis

A number of taxonomic indices and measures of community structure, including abundance (at the individual and generic levels), relative abundance of particular

taxonomic groups, and diversity indices (i.e., Shannon-Wiener) will be calculated based on the taxonomic data. These measures of macroinvertebrate community structure will be compared among sampling stations to: (1) evaluate whether the macroinvertebrate community located adjacent to the site has been affected relative to the reference area, and (2) provide information on whether potential impacts detected adjacent to the site are attenuated in sampling stations located farther downstream.

4.3.5 Data Analysis Techniques/Metrics

A biostatistician will review the taxonomic data with multivariate analytical procedures such as principal elements and clustering analyses, as well as diversity indices. Raw taxonomic data will be summarized to estimate several numerical evaluation metrics, each designed to measure a different component of overall community structure. The calculated metric values for each station will be scored (i.e., assigned a point value) based on comparison with the reference station(s). Finally, the metric scores for each potentially impacted station will be summed and compared with the score for the reference station (or regional database). Based on this final ratio, a qualitative descriptor (e.g., "not-impaired," "moderately impaired," "severely impaired") will be assigned to each station.

4.4 Rationale and Plans for Fishery Evaluation

The condition of the fishery in Plow Shop Pond and Cold Spring Brook Pond may provide a meaningful index of water and sediment quality. Fish occupy various trophic levels in the aquatic ecosystem and are directly and indirectly affected by physical and chemical changes in their environment. Fish are recommended for use in biomonitoring programs because (USEPA, 1989): regulators and the general public understand the effects of pollution on fish; fisheries have economic, recreational, and aesthetic values; the identification of fish is relatively easy; and the environmental requirements of many fish are known.

The intent of the fishery evaluation is to provide qualitative baseline information regarding:

- fish species present

- relative abundance of each species
- size distribution of the fish species present
- gross external pathological condition of the species present
- trophic structure of the fish community
- presence or absence of recreationally important fish species
- candidate species for fish tissue analysis

The fishery evaluation program is not intended to provide an inventory or survey of all fish species existing in this resource area, but rather to serve as a baseline information-gathering tool to assist with the planning of any additional studies, and with the risk management decision-making process.

4.4.1 Station Locations

Fish sampling locations will be chosen to evaluate the fish community in areas of potential impact. At Plow Shop Pond, these locations are tentatively identified in the large cove on the west side of the pond and along the east side of the pond. The study is not designed to monitor fish movement through the culvert. If fish are not available for sampling at the initial locations, other areas of the pond will be fished. At Cold Spring Brook Pond, the eastern third of the pond will be fished.

In siting the individual sampling stations, care will be taken so that the various stations are as comparable as possible with respect to any water movement, substrate composition, canopy coverage, and water depth. Information regarding the physical attributes of the aquatic habitat (including the nature of the substrate and aquatic macrophyte characteristics) and water quality parameters (i.e., dissolved oxygen, temperature, pH, and conductivity) will be collected at each sampling station. These observations will be recorded on field data sheets similar to those for collection of macroinvertebrate data.

4.4.2 Fish Sample Collection

Fish samples for the study of fish communities (and for tissue analysis) will be collected primarily by electrofishing. This technique employs an electric current to immobilize fish, which are then captured with a net. Electrofishing can be conducted either from shore or from a boat in freshwater with a normal conductivity between 100 to 500 micromhos per centimeter (Reynolds, 1983). Night electrofishing will occur from an aluminum boat with boom-mounted electrodes and a live well.

If all habitat types and sampling stations cannot be adequately sampled via electrofishing, it may be necessary to conduct additional sampling with active and/or passive fish capture techniques. Passive sampling gear may include gill nets and/or minnow traps, and active fish capture methods include the use of nylon haul seines. If snag-free areas can be located within Plow Shop Pond, 25-foot panels of monofilament experimental gill net (0.5-to-2-inch mesh) may be deployed at each sampling location. These nets will be placed in the morning, checked twice per day, and allowed to set overnight; after checking nets the following morning, gill nets will be retrieved. Use of gill nets may be an effective method to capture brown bullheads in Plow Shop Pond. Any minnow traps employed to collect small fish in the shallows of Plow Shop Pond will be baited and set in the morning, checked twice per day, allowed to set overnight, and checked the following morning. If nylon haul seines are employed at Plow Shop Pond, they will be used in open, shallow water. Seine nets will be operated by wading into the shallows from shore and dragging the seine net between two poles.

To avoid unnecessary impact or depletion of the fishery resource, destructive sampling methods will be avoided, if possible, during fishery characterization.

All captured fish will be kept alive in a holding tank or live well, until released or selected for tissue analysis. Fish will be identified by species, and the number of individuals of each collected species will be recorded. Specimens chosen for laboratory analysis will be measured (total length) to the nearest centimeter and weighed (mass) to the nearest gram.

4.4.3 Sample Processing

All fish will be keyed to species and voucher samples will be placed in sample jars containing 10 percent formalin. Larger specimens will be slit on the right side to allow the fixative to reach internal organs (USEPA, 1973). After the voucher samples have been fixed, they will be transferred to 70 percent ethanol. If necessary, duplicates of the voucher specimens will be sent to recognized experts in the ichthyological field for taxonomic confirmation.

Representative fish collected from each taxa will be measured on a fish measuring board. Any gross morphological or exterior pathological abnormalities will be noted, including but not limited to, tumors, lesions, and structural or bone defects. Results of seine netting will be expressed as Catch per Unit Effort (or Numbers of Fish per Area Sampled), whereas gill netting results will be expressed as Numbers of Fish per Length of Net per Unit Time.

All samples will be labeled in the field immediately upon collection and the following information will be included on each label: date of sample retrieval; water body; location (town, county, state); station identification number; replicate number; type of sampling method used; and sampling personnel.

Sample Collection Forms will be completed for each unit effort (i.e., for each pull of a hand-held seine). These forms will include the client; site name; project number; sampling station name; species of sample collected; number of animals per sample collected; number of animals per sub-sample processed; physical characteristics of the sampling station (e.g., depth, temperature, turbidity, conductivity, water quality parameters); date and time of collection; name(s) of field personnel; and any comments relative to the sampling station or effort (e.g., flow and vegetation).

4.4.4 Data Analysis

A number of taxonomic indices and measurements of community structure, including abundance (at the individual and generic levels), relative abundance of particular taxonomic groups, and diversity indices (i.e., Shannon-Wiener), will be calculated based on the fish data. These measures of the fish community structure will be compared among sampling stations to provide baseline ecological information regarding the fishery.

If sufficient fish samples are collected to warrant further analysis, raw taxonomic data will be summarized to estimate numerical evaluation metrics, which will be designed to measure a different component of overall community structure. Habitat quality and its effects on the fish community may be assessed via the Index of Biological Integrity (IBI) or another suitable index; IBI is composed of 12 metrics that evaluate species composition and richness, trophic composition, abundance, and condition (USEPA, 1989). The calculated metric values for each sampling station (or for the pond as a whole) will be scored and compared to a regional database (if a suitable database can be located). Based on this final comparison, a qualitative descriptor (e.g., "best," "average," "worst") will be assigned to each station according to IBI guidelines.

4.5 FISH TISSUE ANALYSIS

Fish tissue analysis for contaminants may provide information regarding those compounds that bioaccumulate and/or bioconcentrate in food chains. While contaminants in fish flesh can indicate exposure to bioavailable compounds, the absence of fish tissue contamination does not necessarily indicate the converse.

The Fish Tissue Sampling and Analysis Plan prepared for Fort Devens Group 1A sites provides details concerning proposed fish tissue sampling (ABB-ES, 1992b). Fish from three trophic levels will be collected for tissue analysis from Plow Shop Pond to assess bioaccumulation and bioconcentration of contaminants. A total of 27 samples, both whole fish and fish fillets, will be analyzed for PAL metals and pesticides and PCBs. A total of 17 fish tissue samples from Cold Spring Brook Pond will be analyzed for the same parameters. Table 3 summarizes the proposed tissue sampling program and Table 4 presents anticipated analytical reporting limits.

4.5.1 Sampling Station Locations

The number and locations of sampling stations for collection of fish for tissue analysis will take into account project objectives, habitat, the results of the previous fish sampling program, and contaminant distribution. Sampling stations will be located in areas that likely have been affected by landfill activities. The number and location of sampling stations will depend on the known extent of

contamination, fate and transport considerations (e.g., depositional areas), and habitat.

4.5.2 Target Species Selection

The target species will be chosen based on a number of criteria, including, but not limited to human fishery utilization; abundance; size; migratory behavior; ecological importance; position in food chain; and metabolism (USEPA, 1989). Additional sampling variables will be reviewed, including but not limited to the number of species; age, size, and type of species; legal catch limit; commercial and/or recreational importance; collection of duplicate, replicate, and/or laboratory QC samples; and the number of individual organisms per sample.

Sampling design will be carefully reviewed to confirm that samples are collected at an appropriate time of year. Seasonal variations in tissue residue concentrations may result from changes in food type, feeding level, metabolism, and reproductive stages (USEPA, 1991a). Availability of target species at sites may also be influenced by season.

Depending on site-specific conditions (e.g., habitat, nature of contamination, infaunal diversity, economic and/or recreational importance, and human health concerns), fish sampled will represent three different trophic levels (e.g., primary consumer, secondary consumer, tertiary consumer) or feeding guilds (e.g., bottom feeder and top feeder). For instance, the golden shiner (*Notemigonus crysoleucas*) or sunfish species (*Lepomus* sp.) may be used to represent a foraging fish feeding on planktonic crustaceans, algae, and aquatic insects. A bullhead species (*Ictalurus* sp.) may be sampled to represent a bottom feeder, and largemouth bass (*Micropterus salmoides*) or chain pickerel (*Esox niger*) may represent a tertiary consumer of recreational importance.

4.5.3 Sample Collection

Fish will be collected primarily by electrofishing. However, depending on site-specific conditions, other methods, such as seining, dip-netting, or passive netting may be used (USEPA, 1989). Health and safety concerns including, but not limited to, site contamination, water flow, electrical current, and bottom substrates, may influence sample collection techniques. The initial phase of the

fish sampling program will help establish the mode of fish collection for tissue analysis.

The same species will be collected at each of the sampling locations. All animals will be identified by genus and species. Voucher specimens of each species collected will be obtained, labeled, preserved, and archived (see Subsection 4.4.3). Sufficient fish biomass will be collected to yield a laboratory homogenized tissue sample of one to two cups, unless prior laboratory consultation results in an alternative requirement. If large numbers of any species are caught at a sampling station, an appropriate sub-sample of individual fish will be selected from the sample. Sub-samples will be selected randomly based on project goals and/or prior consultation with the project statistician. If necessary, animals will be measured in the field. Field measurements include, but are not limited to, total length, mass, and width. Required field measurements and any observed gross abnormalities (e.g., tumors and scars) will be recorded on Sample Collection Forms.

Newly collected fish will be placed within a Ziploc bag. Identical sample labels will be placed on the exterior of the sample package and on the Sample Collection Form.

4.5.4 Sample Labeling, Shipping, and Handling

Sample labels will include the site name; project number; sampling station name; species of sample collected; number of animals per sub-sample processed; date and time of collection; and name(s) of field personnel. Each sample collected for analysis will be assigned an alphanumeric number unique to the sample and station.

Sample Collection Forms will list the client; site name; Sample Identification Number; Field Sampling Number; sampling location; species of sample collected; number of animals per sample collected; sampling technique; number of animals per subsample processed; physical characteristics of the sampling station (i.e., depth, temperature, turbidity, conductivity, water quality parameters); date and time of collection; name(s) of field personnel; and any comments relative to the sampling station or effort (e.g., flow and vegetation).

Following sample collection, all samples will be kept on ice and all collected samples will be shipped to the laboratory on a daily basis, at the end of each collection day. Prior to shipping samples, Sample Collection and Field COCs will be completed, copied, and shipped with fish samples to the laboratory. Copies of these forms will be maintained in project files.

4.5.5 Analytical Sample Processing

Whole fish and fish fillets will be analyzed for PAL inorganics and pesticides and PCBs that may pose a potential risk to aquatic life at the site (E&E, 1992a).

Samples to be analyzed for inorganics will be prepared according to *Methods for the Determination of Metals in Environmental Samples* (USEPA, 1991b). Analysis will be by USEPA CLP methodology. Samples to be analyzed for pesticides and PCBs will be extracted using USEPA Method 3540 and analyzed by USEPA Method 8080 following florisil and optional gel permeation cleanup.

Additional details regarding the fish tissue analytical program, methods of sample preparation and analysis, and QA/QC will be presented in a separate fish tissue sampling and analysis plan.

4.5.6 Data Analysis

Residual concentrations of contaminants in fish tissues may indicate compounds that bioaccumulate or bioconcentrate. Depending upon consultation with the project statistician, and site-specific circumstances (e.g., numbers of fish per sample, numbers of samples, and levels of contaminants), appropriate statistical analyses will be conducted. Depending on the final scope of work, data analysis may result in comparisons of fish tissue contaminant residues to a number off standards, including, but not limited to: any applicable regional reference information; any applicable reference information or standards of the Massachusetts Division of Fisheries and Wildlife; any applicable reference information or standards of the MADEP; applicable standards set by the U.S. Food and Drug Administration; fish tissue level standards based on existing USEPA Ambient Water Quality Criteria; the modeled results from the risk assessment (E&E, 1991); and post-remedial action results.

Additional details regarding the fish tissue data analysis program will be developed as needed.

5.0 PERSONNEL REQUIREMENTS

The project organization structure is illustrated in Figure 9. Solid lines on the figure depict direct lines of control while dotted lines indicate channels of communication. Rationale for project organization and resource allocation are discussed in the POP. QA/QC procedures and responsibilities for ABB-ES, AEC, and ESE Laboratory personnel are also described in the POP.

5.1 TASK ORDER STAFFING

The duties, functions, and responsibilities associated with each task are detailed in the following paragraphs.

Program Manager. The Program Manager for ABB-ES' AEC efforts is Mr. Joseph T. Cuccaro. He is responsible for providing direction, coordination, and continuous monitoring and review of the program. His responsibilities include initiating program activities; participating in work plan preparation; coordinating staff assignments; assisting in the identification and fulfillment of equipment and special resource needs; monitoring all task activities to confirm compliance with schedule, fiscal, and technical objectives; maintaining communications both internally and with the AEC Contracting Officer's Representative (COR) through continuous interaction, thereby allowing quick resolution of potential problems; providing final review and approval of work plans, task deliverables, schedules, contract changes, and manpower allocations; and developing coordination among management, field teams, and support personnel to maintain consistency of performance.

Project Manager. The Project Manager for ABB-ES' Fort Devens efforts, Mr. Paul Exner, P.E., has the day-to-day responsibility for conducting the Fort Devens project. The Project Manager is responsible for confirming the appropriateness and adequacy of the technical or engineering services provided for a specific task; developing the technical approach and level of effort required to address each element of a task; supervising day-to-day conduct of the work, including integrating the efforts of all supporting disciplines and subcontractors for all tasks; overseeing the preparation of all reports and plans; providing for QC and quality review during performance of the work; confirming technical integrity, clarity, and

usefulness of task work products; forming a task group with expertise in disciplines appropriate to accomplish the work; reviewing and approving sampling tests and QA plans, which include monitoring site locations, analysis methods to be used, and hydrologic and geophysical techniques to be used; developing and monitoring task schedules; supervising task fiscal requirements (e.g., funds management for labor and materials), and reviewing and approving all invoicing actions; and providing day-to-day communication, both within the ABB-ES team and with the AEC COR, on all task matters including task status reporting.

Corporate Officer. ABB-ES' Corporate Officer, William R. Fisher, P.E., is responsible for ensuring that a contract for the services to be provided has been executed; necessary corporate resources are committed to conduct the program activities; corporate level input and response is readily available to both the ABB-ES team and the AEC COR; and assistance is provided to the Program and Project Managers for project implementation.

Technical Director and Project Review Committee. The members of the Project Review Committee for this Task Order are Mr. James Buss, P.G.; Mr. William Siok, P.G.; and Mr. Allen Ikalainen, P.E. Mr. Buss will serve as Technical Director and will be responsible for the overall technical quality of the work performed; he also will serve as chairman of the review committee. The function of this group of senior technical and/or management personnel is to provide guidance and oversight on the technical aspects of the project. This is accomplished through periodic reviews of the services provided to confirm they represent the accumulated experience of the firm, are being produced in accordance with corporate policy, and live up to the objectives of the program as established by ABB-ES and AEC.

Quality Assurance Supervisor. Mr. Christian Ricardi is the QA Supervisor for ABB-ES' AEC program and this project. The QA function has been established so that appropriate protocols from AEC, Commonwealth of Massachusetts, and USEPA Region 1 are followed. In addition, the QA Supervisor must confirm that QC plans are in place and implemented for each element of the task. The QA Supervisor reports directly to the Program Manager but is responsible to the Project Manager in matters related to management of the QA/QC work element. The QA Supervisor is independent of the Project Manager relative to corrective action. The QA Supervisor has authority to stop work that is not in compliance

with the POP, provided he has the concurrence of the AEC Chemistry Branch, the Program Manager, the COR, and the Contracting Officer.

Health and Safety Supervisor. Ms. Cynthia E. Sundquist is the Health and Safety Supervisor for the Fort Devens project, reporting directly to the Project Manager. She has stop work authority to prevent or mitigate any unacceptable health and safety risks to project personnel, the general public, or the environment. Responsibilities of this position include confirming that the project team and, in particular, field personnel, comply with the ABB-ES HASP; helping the Program Manager and Project Manager develop the site-specific HASP; making certain that the HASP is distributed to appropriate personnel; and informing the Program Manager and the appropriate AEC personnel in the specified manner when any health- or safety-related incident occurs.

Contract Manager. Ms. Elaine H. Findlay is the Contract Manager for the Fort Devens effort. The Contract Manager supports the Program Manager and Project Manager in all contractual matters, providing a liaison between contract representatives for AEC and all subcontracted services.

Project Administrator. Ms. Colleen Walker is the Project Administrator for the Fort Devens effort. The Project Administrator supports the Program Manager and Project Manager in the day-to-day monitoring of fiscal, schedule, and documentation requirements. She is responsible for maintaining the necessary systems to support budget monitoring and controls, and schedule monitoring and maintenance; and for controlling the flow and processing of documentation.

Task Leader. Mr. Stanley Reed will serve as Task Leader for the Fort Devens Groups 1A Field Investigation. As a Task Leader, he is responsible for planning all ABB-ES' geologic and hydrogeologic investigations at Fort Devens. He also is responsible for the interpretation of all chemical and hydrogeologic information and data for the preparation of the Group 1A Field Investigations Report.

Field Operations Leader. Mr. Douglas Pierce will serve as the Field Operations Leader for the Fort Devens Field Program. As Field Operations Leader he is responsible for conducting the field program in accordance with procedures outlined in the Work Plan and POP.

Laboratory/Data Management Leader. Ms. Sorrell MacKay, as the coordinator of laboratory services, is responsible for implementing and maintaining the Fort Devens analytical program. Her responsibilities as the Laboratory Management Leader will include coordination with the Project Manager, QA Supervisor, and the analytical subcontractor on overall project and individual site analytical efforts. As the Data Management Leader, Ms. MacKay is responsible for operating and maintaining the database management systems committed to AEC projects.

5.2 SUBCONTRACTORS

The following services and/or activities will be performed by subcontractors during the Group 1A field investigation activities at Fort Devens: field drilling and monitoring well installation, surveying, and laboratory chemical analysis.

Drilling Services. New Hampshire Boring, Inc., from Derry, New Hampshire, will be subcontracted to provide the required drilling services. Rossfelder Corp. from San Diego, California, will be contracted to provide the proposed vibratory drilling services. The Field Operations Leader will be responsible for coordinating and overseeing the activities of the drilling and coring subcontractors.

Surveying Services. Howe Surveying Associates, Inc., of North Chelmsford, Massachusetts, and/or Golden Land Survey, Inc., from Plymouth, Massachusetts, professional land surveying companies registered in the Commonwealth of Massachusetts, will be subcontracted to establish map coordinates and elevations for new monitoring wells and sediment sampling locations. Surveying activities will be coordinated and monitored by the Field Operations Leader, who will keep the Project Manager informed on a day-to-day basis.

Laboratory Chemical Analysis. Analytical services for the Group 1A field investigations at Fort Devens will be subcontracted to Environmental Science & Engineering, Inc. (ESE) of Gainesville, Florida. ESE's analytical program is AEC-approved.

6.0 PROJECT SCHEDULE

ABB-ES' projection of the schedule for the Group 1A Data Gap Activities at Fort Devens is presented in this section. This schedule allows for the regulatory review and approval period specified in the Federal Facility Agreement for all deliverables.

The overall time line schedule (Gantt Chart) for the Fort Devens Group 1A FS is shown in Figure 10. This schedule shows the relationships among major work elements and the schedule of deliverables (plans and reports). The overall project completion will require 38 months. The overall project schedule has been developed assuming joint Army and regulatory review of deliverables.

The field tasks for Data Gap Activities are scheduled to be completed in five-day work shifts during the eight weeks following authorization to proceed. The schedule shows fieldwork commencing in September 1992.

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ABB-ES	ABB Environmental Services, Inc.
AEC	U.S. Army Environmental Center
AMSL	above mean sea level
AOC	Area of Contamination
ARARs	Applicable or Relevant and Appropriate Requirements
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMR	Code of Massachusetts Regulations
COC	chain-of-custody
COR	Contracting Officer's Representative
DQO	Data Quality Objective
EDM	electronic distance meter
E&E	Ecology and Environmental, Inc.
ESE	Environmental Science & Engineering
FS	Feasibility Study
FSP	Field Sampling Plan
HASP	Health and Safety Plan
IBI	Index of Biological Integrity
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MEP	Master Environmental Plan
mm	millimeters
PAH	Polynuclear Aromatic Hydrocarbon
PAL	Project Analyte List
PCB	polychlorinated biphenyl
POP	Project Operations Plan
PVC	polyvinyl chloride
QA	Quality Assurance
QC	Quality Control

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

QAPjP	Quality Assurance Project Plan
RAS	Routine Analytical Service
RI	Remedial Investigation
RBP	Rapid Bioassessment Protocol
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
VOC	volatile organic compound
WET	Wetland Evaluation Technique

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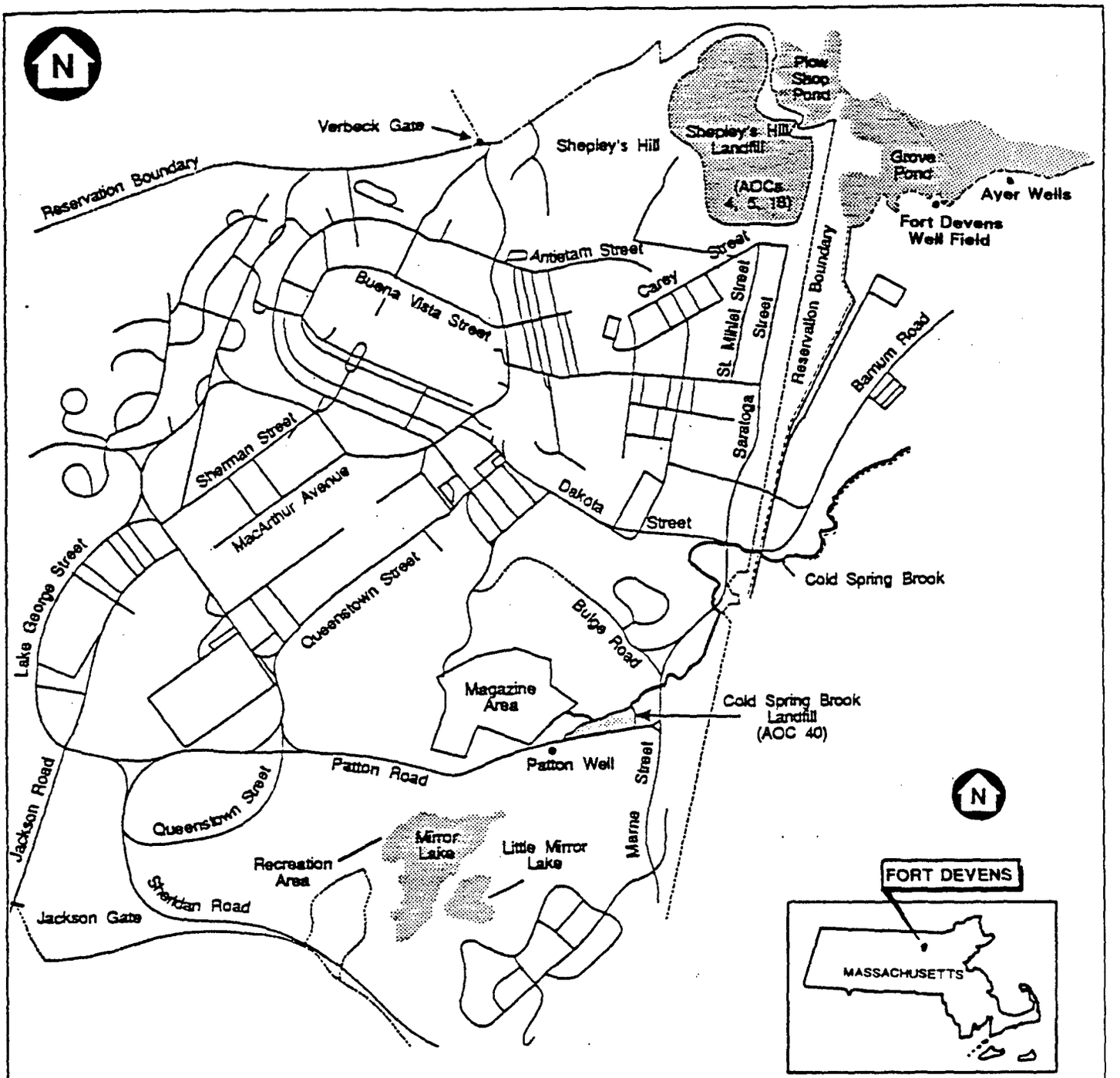


SOURCE: ECOLOGY AND ENVIRONMENT, INC., 1991

Scale in Feet
2112 1056 0 2112

FIGURE 1
SITE LOCATION MAP
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

ABB Environmental Services, Inc.

7005-01

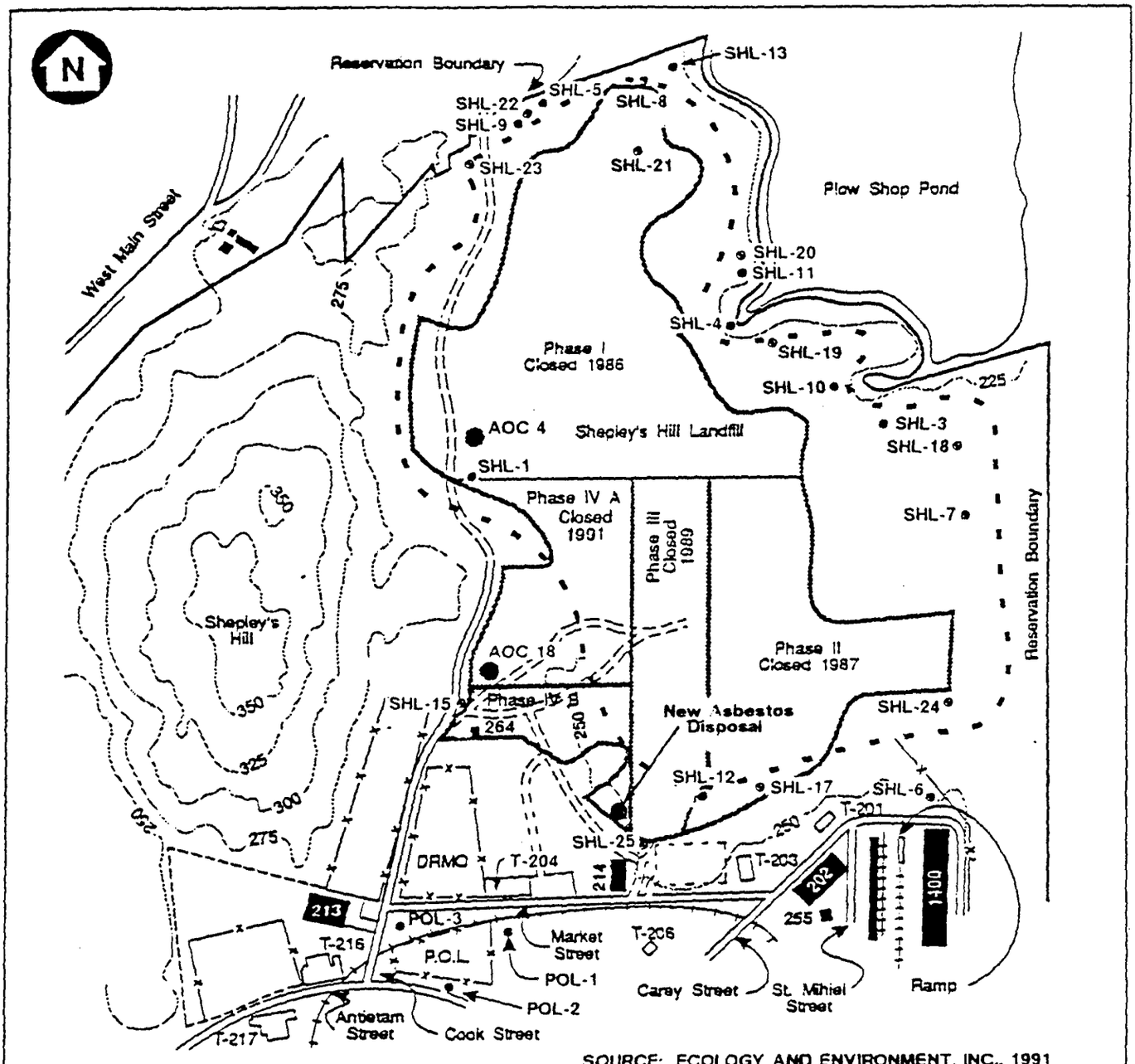


FIGURE 2
SHEPLEY'S HILL LANDFILL
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

ABB Environmental Services, Inc.

7005-01

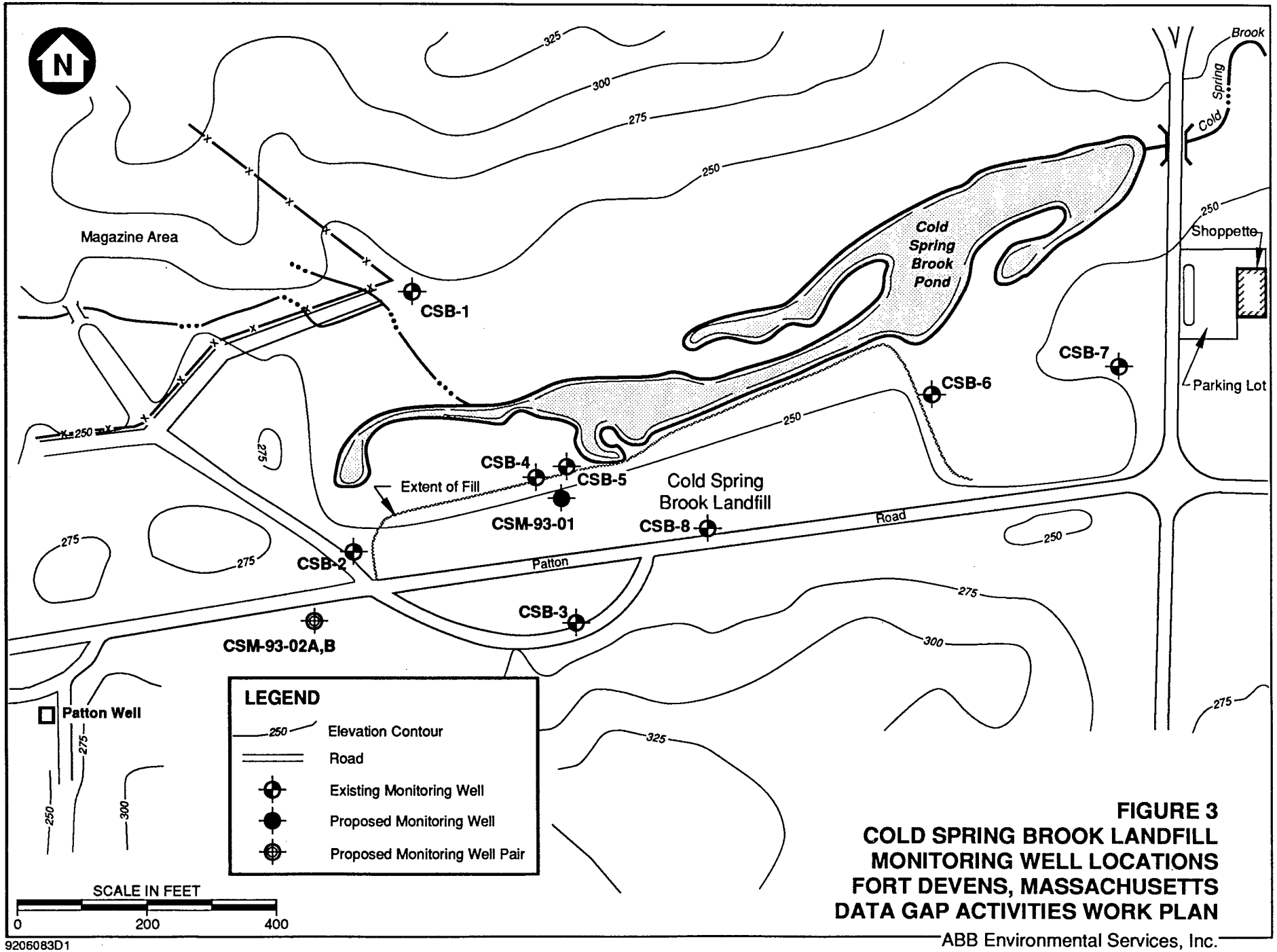


FIGURE 3
COLD SPRING BROOK LANDFILL
MONITORING WELL LOCATIONS
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

ABB Environmental Services, Inc.

9206083D1

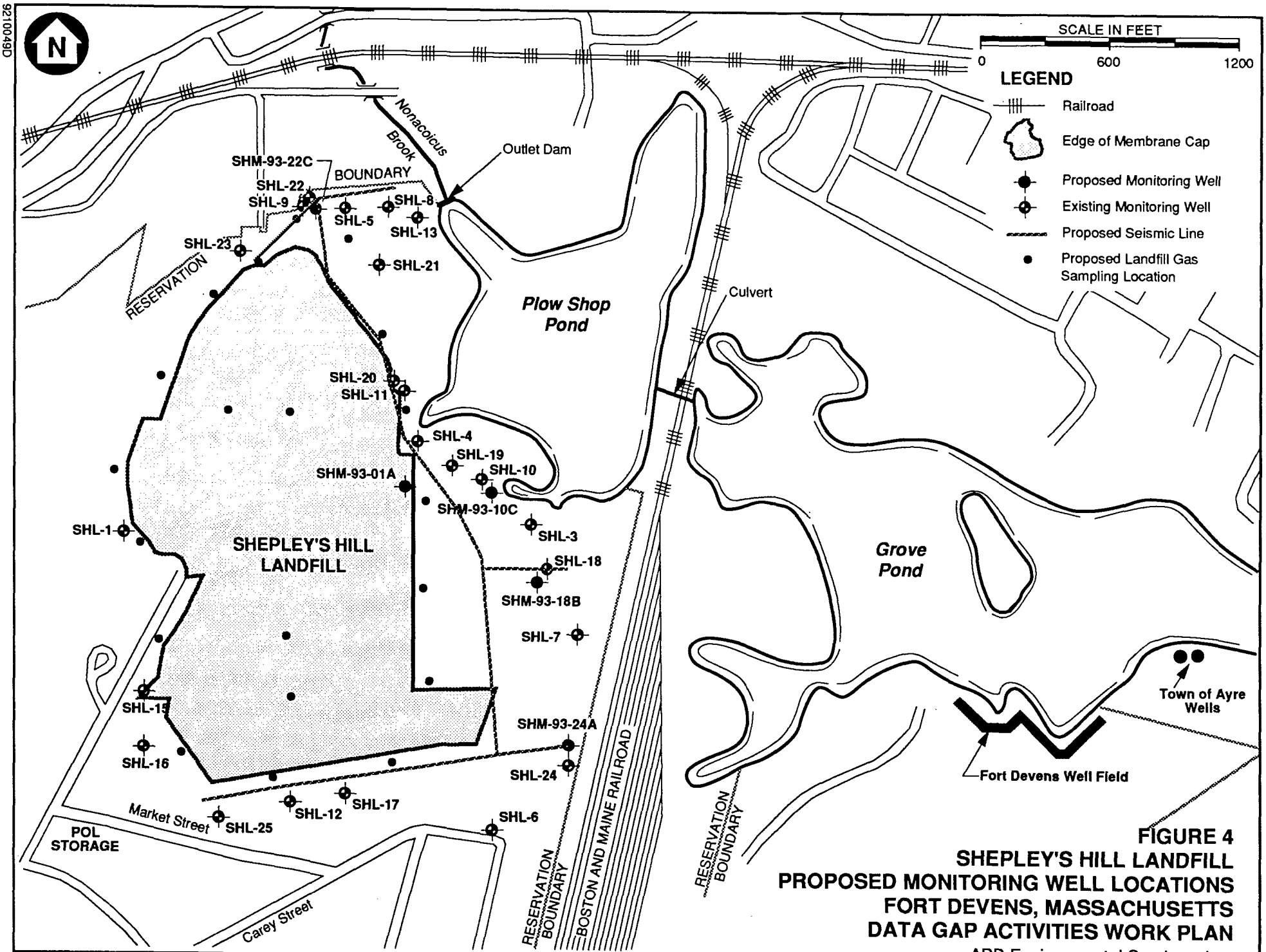


FIGURE 4
SHEPLEY'S HILL LANDFILL
PROPOSED MONITORING WELL LOCATIONS
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN
ABB Environmental Services, Inc.

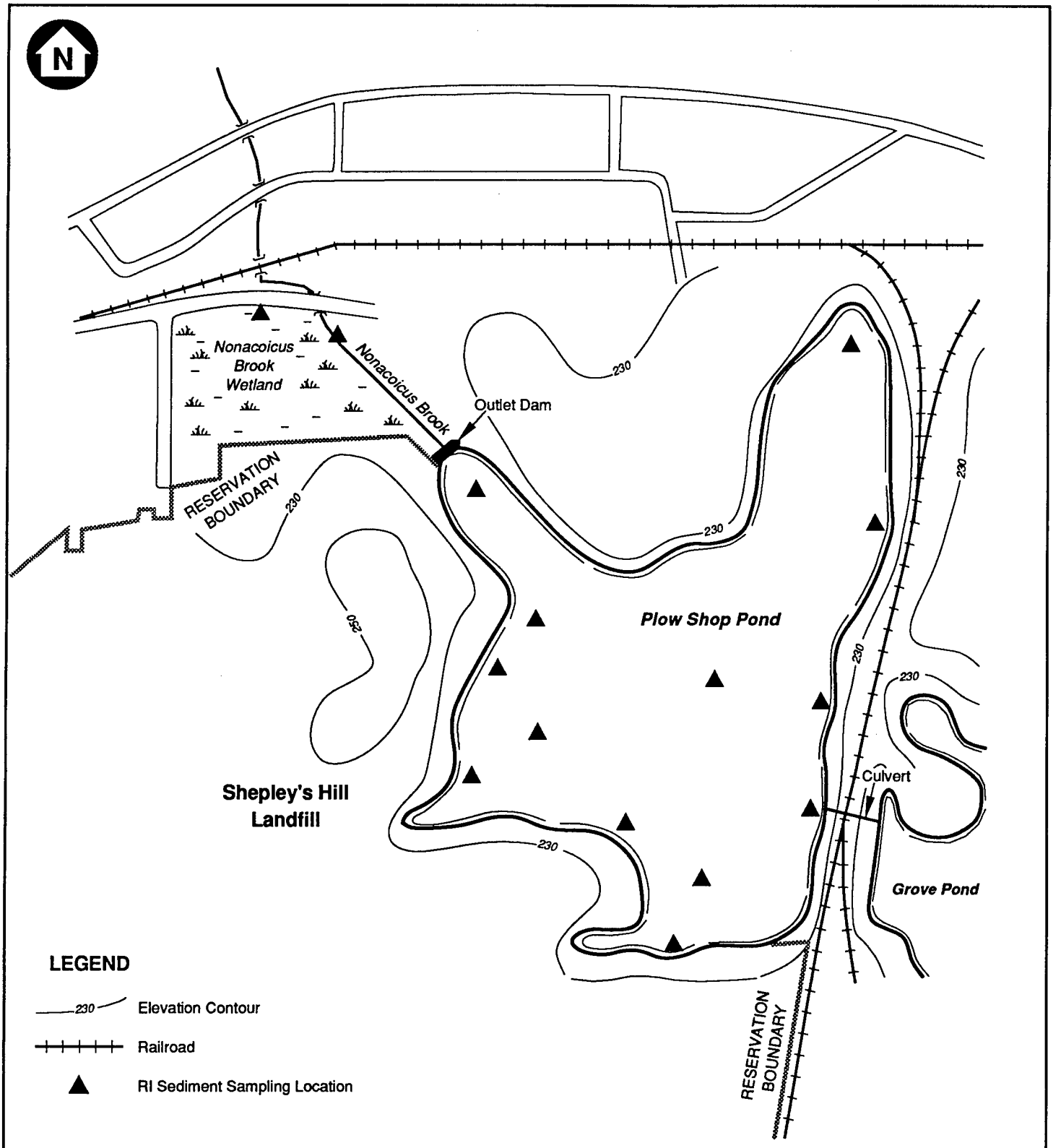


FIGURE 5
SHEPLEY'S HILL LANDFILL
RI SEDIMENT SAMPLING LOCATIONS
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

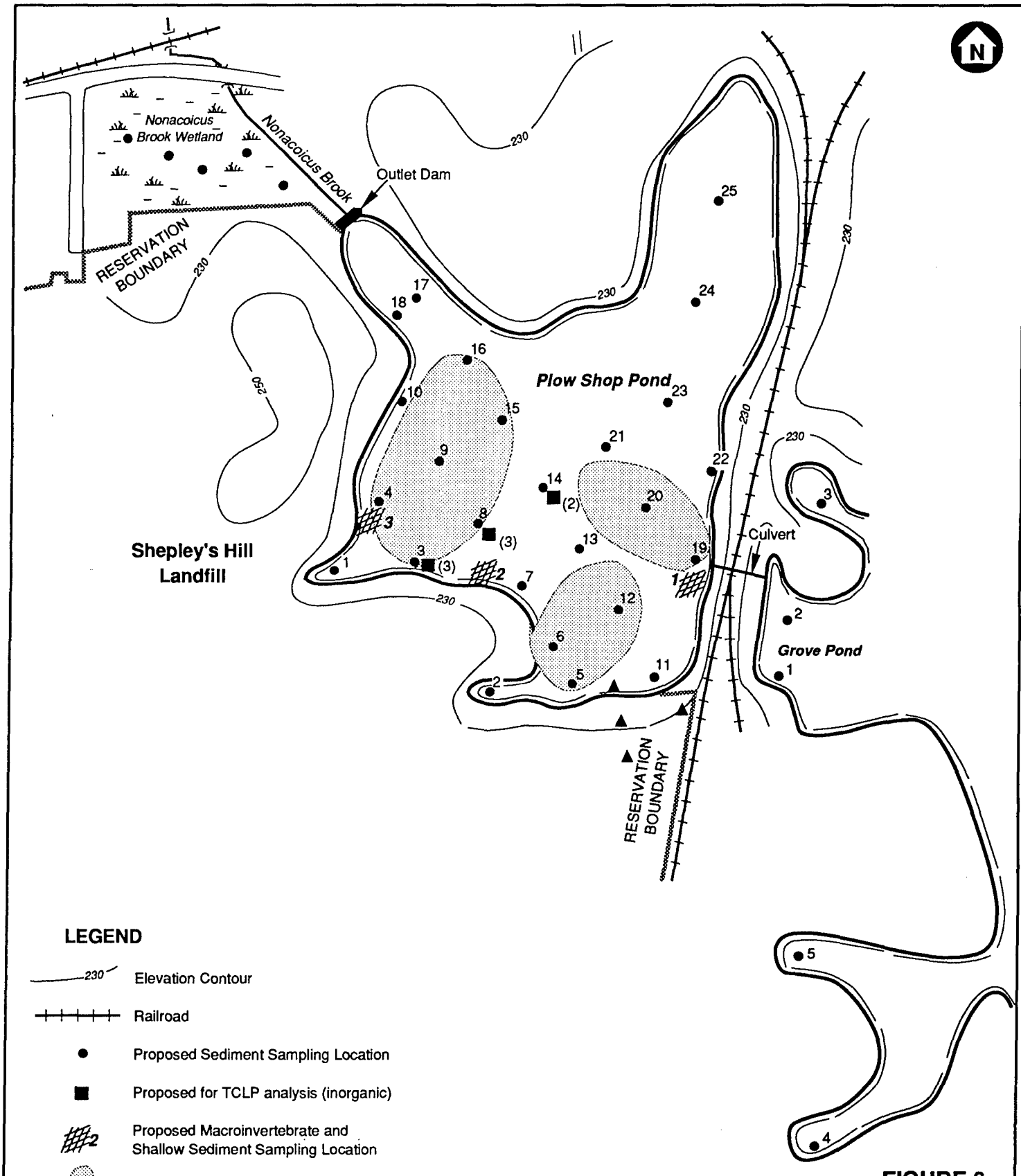


FIGURE 6
SHEPLEY'S HILL LANDFILL
PROPOSED SAMPLING LOCATIONS
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

ABB Environmental Services, Inc.

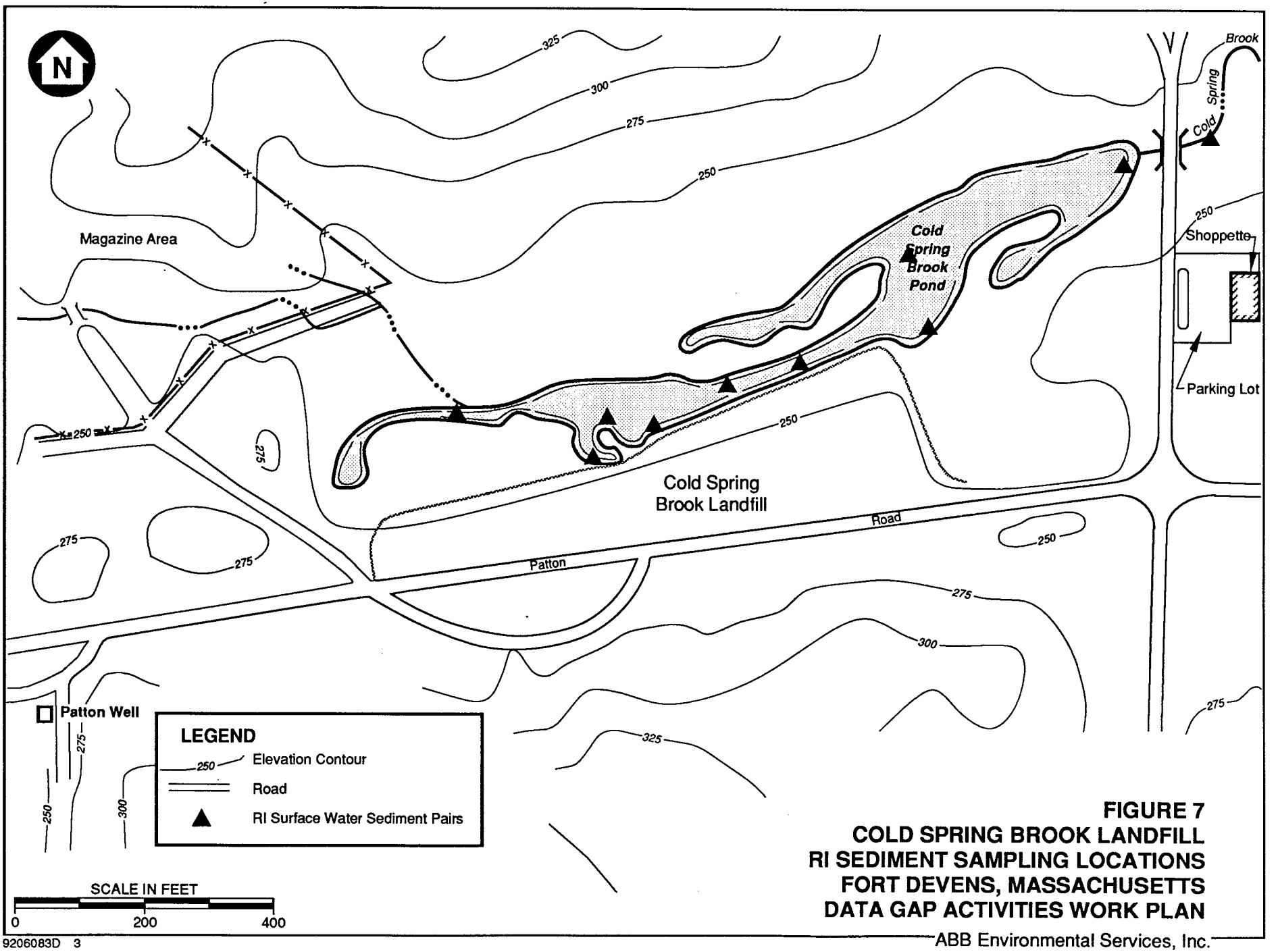


FIGURE 7
COLD SPRING BROOK LANDFILL
RI SEDIMENT SAMPLING LOCATIONS
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

9206083D 3

ABB Environmental Services, Inc.

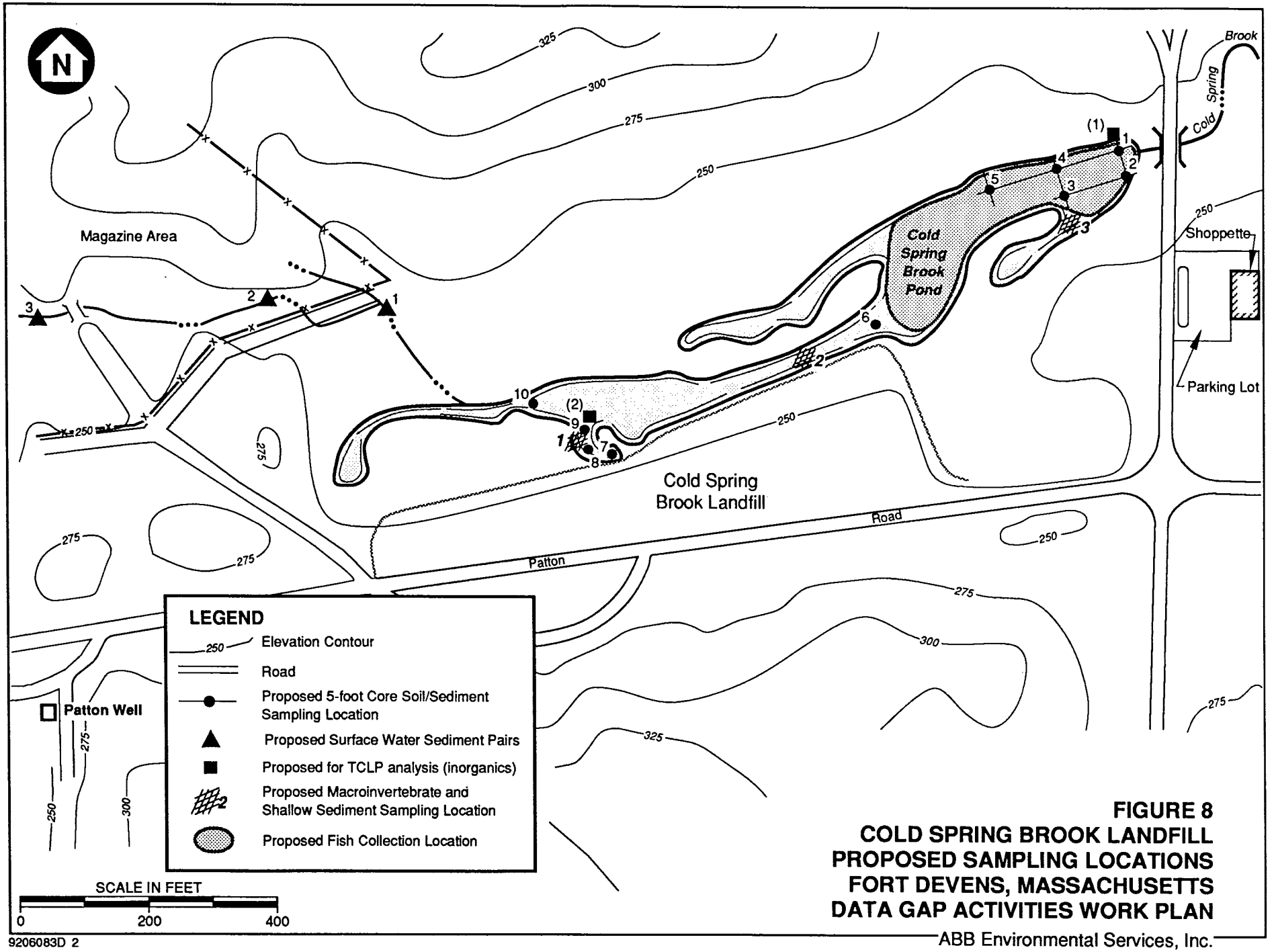


FIGURE 8
COLD SPRING BROOK LANDFILL
PROPOSED SAMPLING LOCATIONS
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

9206083D 2

ABB Environmental Services, Inc.

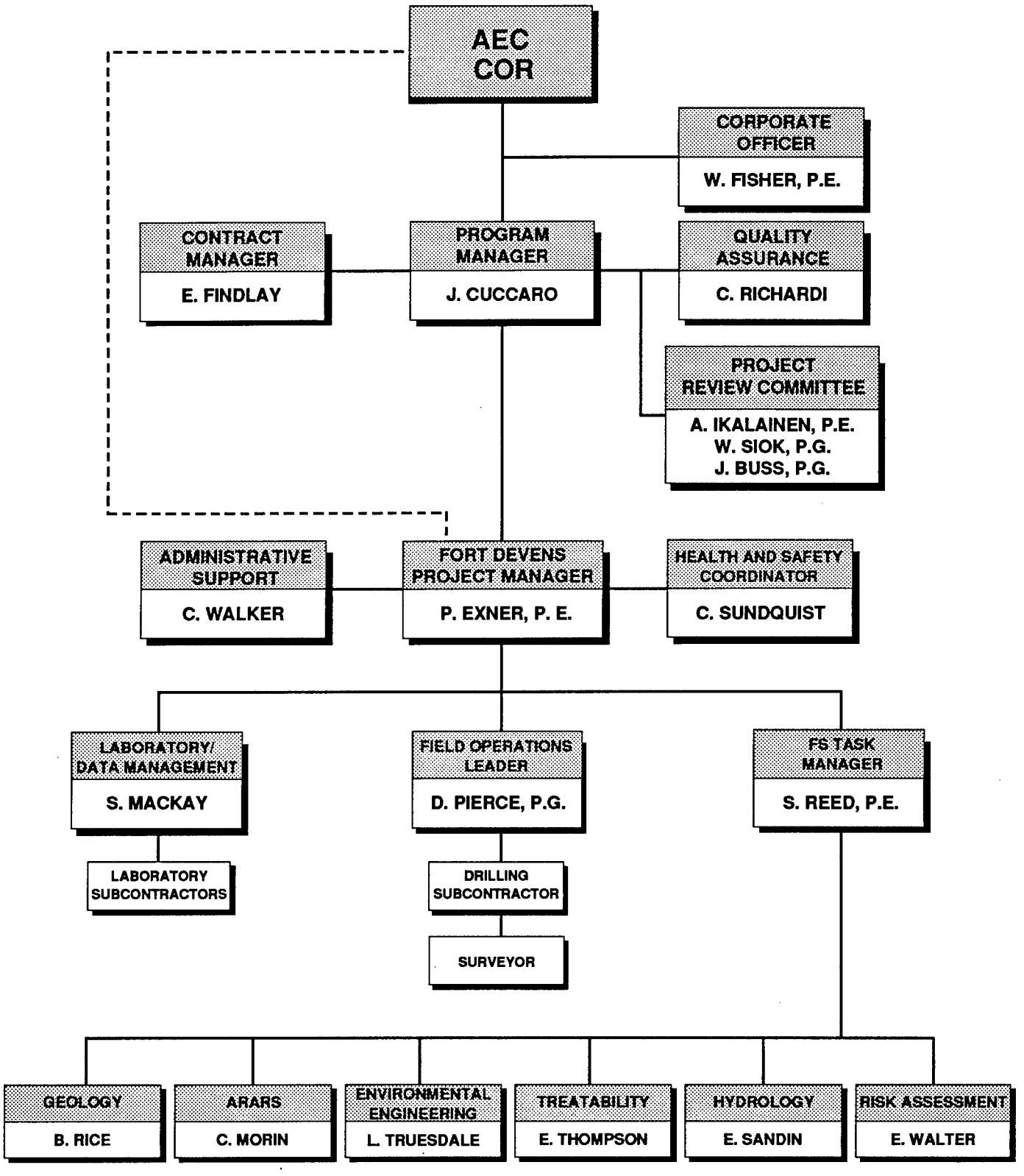
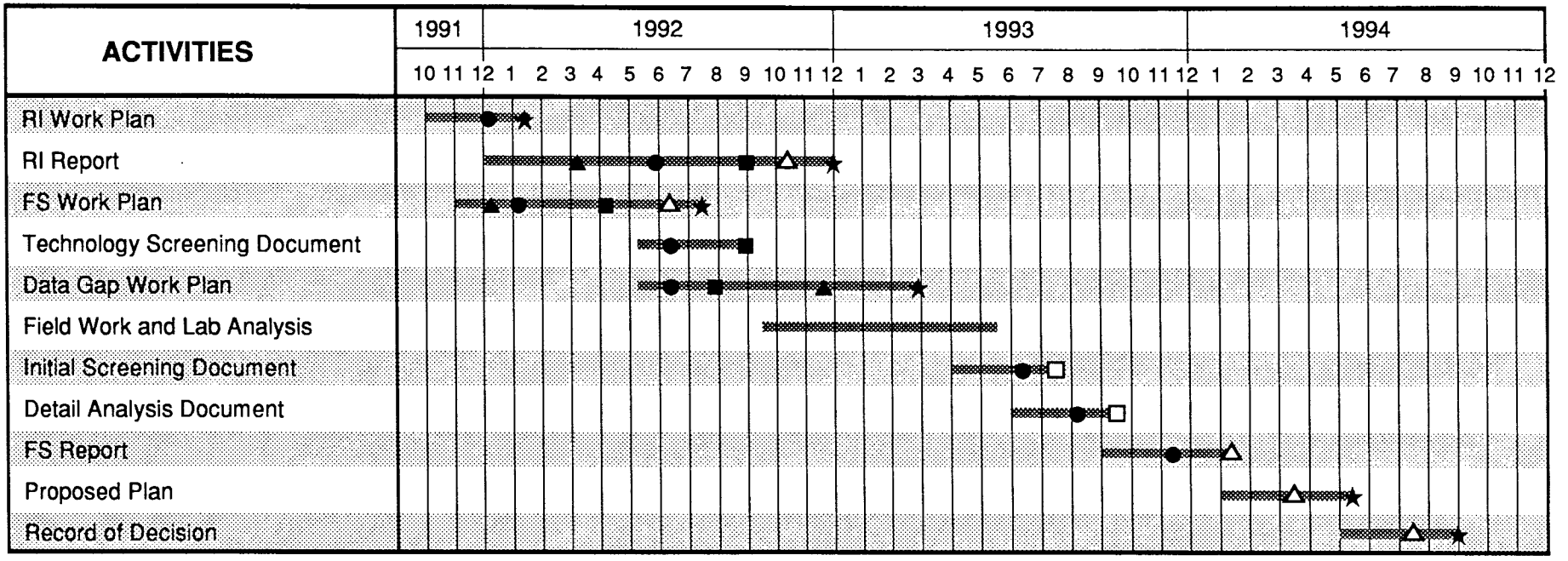


FIGURE 9
PROJECT ORGANIZATION
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

9206139D



LEGEND

- ▲ Army Draft Report
- ● Regulatory Draft Report
- ■ Comment Response Package
- △ Draft Final Report
- ★ Final Report (If Required)
- □ Meeting Notes

FIGURE 10
FS SCHEDULE GROUP 1A SITES
FORT DEVENS, MASSACHUSETTS
DATA GAP ACTIVITIES WORK PLAN

ABB Environmental Services, Inc.

TABLE 1
SITE IDENTIFICATION AND FIELD SAMPLE NUMBERING SYSTEM

FORT DEVENS FIELD INVESTIGATION - GROUPS 1A
FORT DEVENS, MASSACHUSETTS

SITE IDENTIFICATION (10 CHARACTERS)

CHARACTER NUMBER									
1	2	3	4	5	6	7	8	9	10
Site Designation: SA number (13, 45, 49, 56, 57, 58, 12, 14, 27, 28, 41, or 42)		Site Type: M = Monitoring Well B = Soil Boring S = Surface Soil D = Sediment W = Surface Water	Hyphen	Year of Activity		Hyphen	Locator number; the number of the boring, monitoring well, sediment sampling location, etc. (01-99)		Shallow to deep designator for monitoring well clusters (A - D)

EXAMPLES: **13M-92-02X** SA 13 monitoring well number 02, drilled in 1992, not part of a well cluster.
13B-92-55X SA 13 soil boring, drilled in 1992, sampling location identifier.

FIELD SAMPLE IDENTIFICATION (8 CHARACTERS)

CHARACTER NUMBER							
1	2	3	4	5	6	7	8
Sample medium/type: M = Monitoring Well (groundwater) B = Soil boring S = Surface Soil D = Sediment W = Surface Water E = Test Pit Soil	Sample type: X = Regular D = Duplicate R = Replicate	SA Number (13, 45, 49, 56, 57, 58, 12, 14, 27, 28, 41, or 42)		Locator Number or Site Identification (01-99)		For Soil Samples: depth of sample in feet below ground. For groundwater, surface water, and sediment samples; sampling round number (X1, X2, etc.)	

EXAMPLES: **SX130300** Surface Soil from SA 13 sample location 03, depth 0 feet below ground.
MD1302X1 Duplicate groundwater sample from SA 13 monitoring well 02, round 1.

continued

TABLE 1
SITE IDENTIFICATION AND FIELD SAMPLE NUMBERING SYSTEM

FORT DEVENS FIELD INVESTIGATION - GROUP 1A
FORT DEVENS, MASSACHUSETTS

FIELD QC SAMPLES (10 CHARACTERS)									
CHARACTER NUMBER									
1	2	3	4	5	6	7	8	9	10
Trip blank (TBK) Sampler blank (SBK)			Hyphen	Year of Sample		Hyphen	Sequential number (200-299)		

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE	#	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
ROUND 1 GROUNDWATER																					
Shepley's Hill Landfill																					
CGW	WELL	Groundwater	SHL-1	MXSH01X1	DV1AW*	295				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-3	MXSH03X1	DV1AW*	296				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-4	MXSH04X1	DV1AW*	297				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-5	MXSH05X1	DV1AW*	298				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-6	MXSH06X1	DV1AW*	299				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-7	MXSH07X1	DV1AW*	300				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-8S	MXSH8SX1	DV1AW*	301				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-8D	MXSH8DX1	DV1AW*	302				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-9	MXSH09X1	DV1AW*	303				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-10	MXSH10X1	DV1AW*	304			X	1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-11	MXSH11X1	DV1AW*	305				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-12	MXSH12X1	DV1AW*	306				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-13	MXSH13X1	DV1AW*	307				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-15	MXSH15X1	DV1AW*	308				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-17	MXSH17X1	DV1AW*	309				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-18	MXSH18X1	DV1AW*	310		X		1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-19	MXSH19X1	DV1AW*	311				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-20	MXSH20X1	DV1AW*	312				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-21	MXSH21X1	DV1AW*	313				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-22	MXSH22X1	DV1AW*	314				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHL-23	MXSH23X1	DV1AW*	315				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-24	MXSH24X1	DV1AW*	316				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHM-93-24A	MXSH24X1	DV1AW*	317				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHL-25	MXSH25X1	DV1AW*	318				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHM-93-01A	MXSH01X1	DV1AW*	319				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHM-93-01B	MXSH01X1	DV1AW*	320				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHM-93-10C	MXSH10X1	DV1AW*	343				1			1	1	1		1	1	1		
CGW	WELL	Groundwater	SHM-93-18B	MXSH18X1	DV1AW*	344				1			1	1	1	1	1	1	1		
CGW	WELL	Groundwater	SHM-93-22C	MXSH22X1	DV1AW*	345				1			1	1	1		1	1	1		

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
Cold Spring Brook Landfill																				
CGW	WELL	Groundwater	CSB-1	MXCS01X1	DV1AW*	321				1	1	1	1		1	1	1			
CGW	WELL	Groundwater	CSB-2	MXCS02X1	DV1AW*	322				1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSB-3	MXCS03X1	DV1AW*	323				1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSB-4	MXCS04X1	DV1AW*	324				1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSB-5	MXCS05X1	DV1AW*	325				1	1	1	1		1	1	1			
CGW	WELL	Groundwater	CSB-6	MXCS06X1	DV1AW*	326				1	1	1	1		1	1	1			
CGW	WELL	Groundwater	CSB-7	MXCS07X1	DV1AW*	327		X		1	1	1	1		1	1	1			
CGW	WELL	Groundwater	CSB-8	MXCS08X1	DV1AW*	328				1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSM-93-01A	MXCS01X1	DV1AW*	329				1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSM-93-02A	MXCS02X1	DV1AW*	330				1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSM-93-02B	MXCS02X1	DV1AW*	331	X			1	1	1	1		1	1	1			
CGW	WELL	Groundwater	PAT-1	MXPA01X1	DV1AW*	332			1	1	1	1	1		1	1	1			
ROUND 2 GROUNDWATER																				
Shepley's Hill Landfill																				
CGW	WELL	Groundwater	SHM-93-24A	MXSH24X2	DV1AW*	333		X	1		1	1	1	1	1	1	1			
CGW	WELL	Groundwater	SHM-93-01A	MXSH01X2	DV1AW*	334	X		1		1	1	1	1	1	1	1			
CGW	WELL	Groundwater	SHM-93-01B	MXSH01X2	DV1AW*	335			1		1	1	1		1	1	1			
CGW	WELL	Groundwater	SHM-93-10C	MXSH10X2	DV1AW*				1		1	1	1		1	1	1			
CGW	WELL	Groundwater	SHM-93-18B	MXSH18X2	DV1AW*				1		1	1	1	1	1	1	1			
CGW	WELL	Groundwater	SHM-93-22C	MXSH22X2	DV1AW*				1		1	1	1		1	1	1			
Cold Spring Brook Landfill																				
CGW	WELL	Groundwater	CSM-93-01A	MXCS01X2	DV1AW*	336		X		1	1	1	1	1	1	1	1			
CGW	WELL	Groundwater	CSM-93-02A	MXCS02X2	DV1AW*	337				1	1	1	1		1	1	1			
CGW	WELL	Groundwater	CSM-93-02B	MXCS02X2	DV1AW*	338				1	1	1	1		1	1	1			
GROUNDWATER SAMPLE SUBTOTAL									36	15	50	50	50	25	50	50	50	0	0	0
Trip Blanks									10	0	0	0	0	0	0	0	0	0	0	0
Duplicates @ 5%								4	2	2	3	3	3	2	3	3	0	0	0	0
MS/MSD Samples @ 5%							3		0	0	0	3	3	2	0	0	0	0	0	0
Rinsate Blanks @ 5%									2	2	3	3	3	2	3	3	0	0	0	0
TOTAL GROUNDWATER SAMPLES									50	19	56	59	59	31	56	56	50	0	0	0

DVFSTAB2.WK1, 16-Mar-93

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
SURFACE WATER/ SEEPS																				
Nonacoicus Brook Wetland																				
CSW	SWAP	Surface Water	SHW-92-01X	WXSH0100	DV1AW*	231			1		1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	SHW-92-02X	WXSH0200	DV1AW*	232			1		1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	SHW-92-03X	WXSH0300	DV1AW*	233			1		1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	SHW-92-04X	WXSH0400	DV1AW*	234			1		1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	SHW-92-05X	WXSH0500	DV1AW*	235			1		1	1	1	1	1	1	1			
Cold Spring Brook Landfill Seeps																				
CSW	SWAP	Surface Water	CSW-92-01X	WXCS0100	DV1AW*	258				1	1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	CSW-92-02X	WXCS0200	DV1AW*	259	X			1	1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	CSW-92-03X	WXCS0300	DV1AW*	260				1	1	1	1	1	1	1	1			
Magazine Area Surface Water																				
CSW	SWAP	Surface Water	MAW-92-01X	WXMA0100	DV1AW*	264				1	1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	MAW-92-02X	WXMA0200	DV1AW*	265				1	1	1	1	1	1	1	1			
CSW	SWAP	Surface Water	MAW-92-03X	WXMA0300	DV1AW*	266				1	1	1	1	1	1	1	1			
Grove Pond Surface Water																				
CSW	POND	Surface Water	GRW-92-01X	WXGR0100	DV1AW*	270			1	1	1		1		1	1	1			
CSW	POND	Surface Water	GRW-92-02X	WXGR0200	DV1AW*	271			1	1	1		1		1	1	1			
CSW	POND	Surface Water	GRW-92-03X	WXGR0300	DV1AW*	272			1	1	1		1		1	1	1			
CSW	POND	Surface Water	GRW-92-04X	WXGR0400	DV1AW*	283			1	1	1		1		1	1	1			
CSW	POND	Surface Water	GRW-92-05X	WXGR0500	DV1AW*	285			1	1	1		1		1	1	1			
Shepley's Hill Landfill Leachate Seeps																				
CSW	DTCH	Leachate	SHW-92-06X	WXSH0600	DV1AW*				1		1	1	1	1	1	1	1			
CSW	DTCH	Leachate	SHW-92-07X	WXSH0700	DV1AW*				1		1	1	1	1	1	1	1			
CSW	DTCH	Leachate	SHW-92-08X	WXSH0800	DV1AW*				1		1	1	1	1	1	1	1			

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	PAL TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
SURFACE WATER SAMPLE SUBTOTAL									13	11	19	14	19	14	19	19	19	0	0	0
Trip Blanks									2	0	0	0	0	0	0	0	0	0	0	0
Duplicates @ 5%								0	1	1	1	1	1	1	1	1	0	0	0	0
MS/MSD Samples @ 5%							1		0	0	0	1	1	1	0	0	0	0	0	0
Rinsate Blanks @ 5%									1	1	1	1	1	1	1	1	0	0	0	0
TOTAL SURFACE WATER SAMPLES									17	13	21	17	22	17	21	21	19	0	0	0

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE	#	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
SOIL/SEDIMENT																					
Plow Shop Pond Sediment																					
CSE	POND	Sediment	SHD-92-01X	DXSH0100	DV1AS*	1						1		1		1				1	1
CSE	POND	Sediment	SHD-92-01X	DXSH01--	DV1AS*	2						1		1		1				1	1
CSE	POND	Sediment	SHD-92-01X	DXSH01--	DV1AS*	3						1		1		1				1	1
CSE	POND	Sediment	SHD-92-02X	DXSH0200	DV1AS*	4						1		1		1				1	1
CSE	POND	Sediment	SHD-92-02X	DXSH02--	DV1AS*	5						1		1		1				1	1
CSE	POND	Sediment	SHD-92-02X	DXSH02--	DV1AS*	6						1		1		1				1	1
CSE	POND	Sediment	SHD-92-03X	DXSH0300	DV1AS*	7						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-03X	DXSH03--	DV1AS*	8			X			1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-03X	DXSH03--	DV1AS*	9						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-04X	DXSH0400	DV1AS*	10						1		1		1				1	1
CSE	POND	Sediment	SHD-92-04X	DXSH04--	DV1AS*	11						1		1		1				1	1
CSE	POND	Sediment	SHD-92-04X	DXSH04--	DV1AS*	12						1		1		1				1	1
CSE	POND	Sand	SHD-92-04X	DXSH04--	DV1AS*	13						1		1		1				1	1
CSE	POND	Sediment	SHD-92-05X	DXSH0500	DV1AS*	14						1		1		1				1	1
CSE	POND	Sediment	SHD-92-05X	DXSH05--	DV1AS*	15						1		1		1				1	1
CSE	POND	Sediment	SHD-92-05X	DXSH05--	DV1AS*	16						1		1		1				1	1
CSE	POND	Sediment	SHD-92-06X	DXSH0600	DV1AS*	17						1		1		1				1	1
CSE	POND	Sediment	SHD-92-06X	DXSH06--	DV1AS*	18						1		1		1				1	1
CSE	POND	Sediment	SHD-92-06X	DXSH06--	DV1AS*	19						1		1		1				1	1
CSE	POND	Sediment	SHD-92-07X	DXSH0700	DV1AS*	20						1		1		1				1	1
CSE	POND	Sediment	SHD-92-07X	DXSH07--	DV1AS*	21						1		1		1				1	1
CSE	POND	Sediment	SHD-92-07X	DXSH07--	DV1AS*	22						1		1		1				1	1
CSE	POND	Sand	SHD-92-07X	DXSH07--	DV1AS*	23						1		1		1				1	1
CSE	POND	Sediment	SHD-92-08X	DXSH0800	DV1AS*	24						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-08X	DXSH08--	DV1AS*	25						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-08X	DXSH08--	DV1AS*	26						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-09X	DXSH0900	DV1AS*	27						1		1		1				1	1
CSE	POND	Sediment	SHD-92-09X	DXSH09--	DV1AS*	28						1		1		1				1	1
CSE	POND	Sediment	SHD-92-09X	DXSH09--	DV1AS*	29						1		1		1				1	1
CSE	POND	Sand	SHD-92-09X	SXSH09--	DV1AS*	30						1		1		1				1	1
CSE	POND	Sediment	SHD-92-10X	DXSH1000	DV1AS*	31						1		1		1				1	1
CSE	POND	Sediment	SHD-92-10X	DXSH10--	DV1AS*	32		X				1		1		1				1	1
CSE	POND	Sediment	SHD-92-10X	DXSH10--	DV1AS*	33						1		1		1				1	1
CSE	POND	Sediment	SHD-92-11X	DXSH1100	DV1AS*	34						1		1		1				1	1
CSE	POND	Sediment	SHD-92-11X	DXSH11--	DV1AS*	35						1		1		1				1	1
CSE	POND	Sediment	SHD-92-11X	DXSH11--	DV1AS*	36						1		1		1				1	1
CSE	POND	Sediment	SHD-92-12X	DXSH1200	DV1AS*	37						1		1		1				1	1
CSE	POND	Sediment	SHD-92-12X	DXSH12--	DV1AS*	38						1		1		1				1	1
CSE	POND	Sediment	SHD-92-12X	DXSH12--	DV1AS*	39						1		1		1				1	1
CSE	POND	Sediment	SHD-92-13X	DXSH1300	DV1AS*	40						1		1		1				1	1

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE	#	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
CSE	POND	Sediment	SHD-92-13X	DXSH13--	DV1AS*	41						1		1		1				1	1
CSE	POND	Sediment	SHD-92-13X	DXSH13--	DV1AS*	42						1		1		1				1	1
CSE	POND	Sand	SHD-92-13X	DXSH13--	DV1AS*	43						1		1		1				1	1
CSE	POND	Sediment	SHD-92-14X	DXSH1400	DV1AS*	44						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-14X	DXSH14--	DV1AS*	45						1		1		1			1	1	1
CSE	POND	Sediment	SHD-92-14X	DXSH14--	DV1AS*	46						1		1		1				1	1
CSE	POND	Sediment	SHD-92-15X	DXSH1500	DV1AS*	47						1		1		1				1	1
CSE	POND	Sediment	SHD-92-15X	DXSH15--	DV1AS*	48						1		1		1				1	1
CSE	POND	Sediment	SHD-92-15X	DXSH15--	DV1AS*	49						1		1		1				1	1
CSE	POND	Sand	SHD-92-15X	DXSH15--	DV1AS*	50						1		1		1				1	1
CSE	POND	Sediment	SHD-92-16X	DXSH1600	DV1AS*	51						1		1		1				1	1
CSE	POND	Sediment	SHD-92-16X	DXSH16--	DV1AS*	52						1		1		1				1	1
CSE	POND	Sediment	SHD-92-16X	DXSH16--	DV1AS*	53						1		1		1				1	1
CSE	POND	Sediment	SHD-92-17X	DXSH1700	DV1AS*	54						1		1		1				1	1
CSE	POND	Sediment	SHD-92-17X	DXSH17--	DV1AS*	55						1		1		1				1	1
CSE	POND	Sediment	SHD-92-17X	DXSH17--	DV1AS*	56						1		1		1				1	1
CSE	POND	Sediment	SHD-92-18X	DXSH1800	DV1AS*	57		X				1		1		1				1	1
CSE	POND	Sediment	SHD-92-18X	DXSH18--	DV1AS*	58						1		1		1				1	1
CSE	POND	Sediment	SHD-92-18X	DXSH18--	DV1AS*	59						1		1		1				1	1
CSE	POND	Sediment	SHD-92-19X	DXSH1900	DV1AS*	60						1		1		1				1	1
CSE	POND	Sediment	SHD-92-19X	DXSH19--	DV1AS*	61						1		1		1				1	1
CSE	POND	Sediment	SHD-92-19X	DXSH19--	DV1AS*	62						1		1		1				1	1
CSE	POND	Sediment	SHD-92-20X	DXSH2000	DV1AS*	63						1		1		1				1	1
CSE	POND	Sediment	SHD-92-20X	DXSH20--	DV1AS*	64		X				1		1		1				1	1
CSE	POND	Sediment	SHD-92-20X	DXSH20--	DV1AS*	65						1		1		1				1	1
CSE	POND	Sediment	SHD-92-21X	DXSH2100	DV1AS*	66						1		1		1				1	1
CSE	POND	Sediment	SHD-92-21X	DXSH21--	DV1AS*	67			X			1		1		1				1	1
CSE	POND	Sediment	SHD-92-21X	DXSH21--	DV1AS*	68						1		1		1				1	1
CSE	POND	Sediment	SHD-92-22X	DXSH2200	DV1AS*	69						1		1		1				1	1
CSE	POND	Sediment	SHD-92-22X	DXSH22--	DV1AS*	70						1		1		1				1	1
CSE	POND	Sediment	SHD-92-22X	DXSH22--	DV1AS*	71						1		1		1				1	1
CSE	POND	Sediment	SHD-92-23X	DXSH2300	DV1AS*	72						1		1		1				1	1
CSE	POND	Sediment	SHD-92-23X	DXSH23--	DV1AS*	73						1		1		1				1	1
CSE	POND	Sediment	SHD-92-23X	DXSH23--	DV1AS*	74						1		1		1				1	1
CSE	POND	Sediment	SHD-92-24X	DXSH2400	DV1AS*	75						1		1		1				1	1
CSE	POND	Sediment	SHD-92-24X	DXSH24--	DV1AS*	76						1		1		1				1	1
CSE	POND	Sediment	SHD-92-24X	DXSH24--	DV1AS*	77						1		1		1				1	1
CSE	POND	Sediment	SHD-92-25X	DXSH2500	DV1AS*	78						1		1		1				1	1
CSE	POND	Sediment	SHD-92-25X	DXSH25--	DV1AS*	79			X			1		1		1				1	1
CSE	POND	Sediment	SHD-92-25X	DXSH25--	DV1AS*	80						1		1		1				1	1

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
Plow Shop Pond Benthic Stations																				
CSE	POND	Sediment	SHD-92-26X	DXSH2600	DV1AS* 81						1		1		1				1	1
CSE	POND	Sediment	SHD-92-27X	DXSH2700	DV1AS* 82						1		1		1				1	1
CSE	POND	Sediment	SHD-92-28X	DXSH2800	DV1AS* 83						1		1		1				1	1
Nonacoicus Brook Wetland																				
CSE	SWAP	Sediment	SHD-92-29X	DXSH2900	DV1AS* 90				1		1	1	1		1			1	1	1
CSE	SWAP	Sediment	SHD-92-29X	DXSH29---	DV1AS* 91				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-29X	DXSH29---	DV1AS* 92			X	1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-30X	DXSH3000	DV1AS* 93				1		1	1	1		1			1	1	1
CSE	SWAP	Sediment	SHD-92-30X	DXSH30---	DV1AS* 94				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-30X	DXSH30---	DV1AS* 95				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-31X	DXSH3100	DV1AS* 96				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-31X	DXSH31---	DV1AS* 97				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-31X	DXSH31---	DV1AS* 98				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-32X	DXSH3200	DV1AS* 99				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-32X	DXSH32---	DV1AS* 100				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-32X	DXSH32---	DV1AS* 101				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-33X	DXSH3300	DV1AS* 102				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-33X	DXSH33---	DV1AS* 103				1		1	1	1		1				1	1
CSE	SWAP	Sediment	SHD-92-33X	DXSH33---	DV1AS* 104				1		1	1	1		1				1	1
Shepley's Hill Landfill Leachate Seeps																				
CSE	DTCH	Sediment	SHD-92-34X	DXSH34---	DV1AS*				1		1	1	1		1				1	1
CSE	DTCH	Sediment	SHD-92-35X	DXSH35---	DV1AS*				1		1	1	1		1				1	1
CSE	DTCH	Sediment	SHD-92-36X	DXSH36---	DV1AS*				1		1	1	1		1				1	1
Grove Pond Sediment																				
CSE	POND	Sediment	GRD-92-01X	DXGR0100	DV1AS* 105				1	1	1		1		1				1	1
CSE	POND	Sediment	GRD-92-02X	DXGR0200	DV1AS* 106				1	1	1		1		1				1	1
CSE	POND	Sediment	GRD-92-03X	DXGR0300	DV1AS* 107				1	1	1		1		1				1	1
CSE	POND	Sediment	GRD-92-04X	DXGR0400	DV1AS* 282				1	1	1		1		1				1	1
CSE	POND	Sediment	GRD-92-05X	DXGR0500	DV1AS* 284				1	1	1		1		1				1	1

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
Cold Spring Brook Pond Sediment																				
CSE	POND	Sediment	CSD-92-01X	DXCS0100	DV1AS*	114				1	1	1	1		1			1	1	1
CSE	POND	Sediment	CSD-92-01X	DXCS01--	DV1AS*	115			X	1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-01X	DXCS01--	DV1AS*	116				1	1	1	1		1				1	1
CSE	POND	Sand	CSD-92-01X	DXCS01--	DV1AS*	117				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-02X	DXCS0200	DV1AS*	118				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-02X	DXCS02--	DV1AS*	119				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-02X	DXCS02--	DV1AS*	120				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-03X	DXCS0300	DV1AS*	121				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-03X	DXCS03--	DV1AS*	122				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-03X	DXCS03--	DV1AS*	123				1	1	1	1		1				1	1
CSE	POND	Sand	CSD-92-03X	DXCS03--	DV1AS*	124				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-04X	DXCS0400	DV1AS*	125				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-04X	DXCS04--	DV1AS*	126				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-04X	DXCS04--	DV1AS*	127				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-05X	DXCS0500	DV1AS*	128				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-05X	DXCS05--	DV1AS*	129	X			1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-05X	DXCS05--	DV1AS*	130				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-06X	DXCS0600	DV1AS*	131				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-06X	DXCS06--	DV1AS*	132				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-06X	DXCS06--	DV1AS*	133				1	1	1	1		1				1	1
CSE	POND	Sand	CSD-92-06X	DXCS06--	DV1AS*	134				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-07X	DXCS0700	DV1AS*	135				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-07X	DXCS07--	DV1AS*	136				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-07X	DXCS07--	DV1AS*	137				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-08X	DXCS0800	DV1AS*	138				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-08X	DXCS08--	DV1AS*	139				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-08X	DXCS08--	DV1AS*	140				1	1	1	1		1				1	1
CSE	POND	Sand	CSD-92-08X	DXCS08--	DV1AS*	141				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-09X	DXCS0900	DV1AS*	142				1	1	1	1		1			1	1	1
CSE	POND	Sediment	CSD-92-09X	DXCS09--	DV1AS*	143			X	1	1	1	1		1			1	1	1
CSE	POND	Sediment	CSD-92-09X	DXCS09--	DV1AS*	144				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-10X	DXCS1000	DV1AS*	145				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-10X	DXCS10--	DV1AS*	146				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-10X	DXCS10--	DV1AS*	147	X			1	1	1	1		1				1	1
CSE	POND	Sand	CSD-92-10X	DXCS10--	DV1AS*	148				1	1	1	1		1				1	1

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
Cold Spring Brook Landfill Leachate Seeps																				
CSE	POND	Sediment	CSD-92-11X	DXCS1100	DV1AS*	149				1	1	1	1		1			1	1	1
CSE	POND	Sediment	CSD-92-11X	DXCS11--	DV1AS*	150				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-11X	DXCS11--	DV1AS*	151				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-12X	DXCS1200	DV1AS*	152	X			1	1	1	1		1			1	1	1
CSE	POND	Sediment	CSD-92-12X	DXCS12--	DV1AS*	153	X			1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-12X	DXCS12--	DV1AS*	154				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-13X	DXCS1300	DV1AS*	155				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-13X	DXCS13--	DV1AS*	156				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-13X	DXCS13--	DV1AS*	157				1	1	1	1		1				1	1
Cold Spring Brook Pond Benthic Stations																				
CSE	POND	Sediment	CSD-92-14X	DXCS1400	DV1AS*	158				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-15X	DXCS1500	DV1AS*	159				1	1	1	1		1				1	1
CSE	POND	Sediment	CSD-92-16X	DXCS1600	DV1AS*	160				1	1	1	1		1				1	1
Magazine Area																				
CSE	SWAP	Sediment	MAD-92-01X	DXCS0100	DV1AS*	167				1	1	1	1		1				1	1
CSE	SWAP	Sediment	MAD-92-02X	DXCS0200	DV1AS*	168				1	1	1	1		1				1	1
CSE	SWAP	Sediment	MAD-92-03X	DXCS0300	DV1AS*	169				1	1	1	1		1				1	1
Cranberry Pond Benthic Stations																				
CSE	POND	Sediment	CRD-92-01X	DXCR0100	DV1AS*	174		X	1	1	1	1	1		1				1	1
CSE	POND	Sediment	CRD-92-02X	DXCR0200	DV1AS*	175	X		1	1	1	1	1		1				1	1
CSE	POND	Sediment	CRD-92-03X	DXCR0300	DV1AS*	176			1	1	1	1	1		1				1	1
Training Area 7A Pond Benthic Stations																				
CSE	POND	Sediment	TAD-92-01X	DXTA0100	DV1AS*	181			1	1	1	1	1		1				1	1
CSE	POND	Sediment	TAD-92-02X	DXTA0200	DV1AS*	182			1	1	1	1	1		1				1	1
CSE	POND	Sediment	TAD-92-03X	DXTA0300	DV1AS*	183			1	1	1	1	1		1				1	1
Railroad Roundhouse																				
CSO	PLUG	Soil (ash)	SHS-93-01	SXSH01X	DV1AS*			X	1	1	1		1		1			1		1
CSO	PLUG	Soil	SHS-93-02	SXSH02X	DV1AS*				1	1	1		1		1					1
CSO	PLUG	Soil (@tanks)	SHS-93-03	SXSH03X	DV1AS*				1	1	1		1		1					1
CSE	POND	Sediment	SHD-93-01	DXSH01X	DV1AS*					1	1		1		1			1		1

TABLE 2
SAMPLING AND LABORATORY ANALYSIS SCHEDULE

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

FILE TYPE	SITE TYPE	MEDIA	SITE ID	SAMPLE ID	LABORATORY SAMPLE #	VAL	MS/ MSD	DUP	PAL VOCs	PAL SVOCs	PAL PCB/PEST	PAL EXPL.	PAL INORGANICS TOTAL	PAL INORGANICS DISSOLV	TOC	TSS, TDS,ALK	FIELD PARAM	TCLP	GRAIN SIZE DIST.	% SOLIDS
Soil Borings																				
CSO	BORE	Soil	SHB-93-24A	BXSH24XX	DV1AS* 339										1					1
CSO	BORE	Soil	SHB-93-01B	BXSH01XX	DV1AS* 340										1					1
CSO	BORE	Soil	CSB-93-01A	BXCS01XX	DV1AS* 341										1					1
CSO	BORE	Soil	CSB-93-02B	BXCS02XX	DV1AS* 342										1					1
CSO	BORE	Soil	CSB-93-02A	BXCS01XX	DV1AS*										1					1
CSO	BORE	Soil	SHB-93-10C	BXSH10XX	DV1AS*										1					1
CSO	BORE	Soil	SHB-93-18B	BXSH18XX	DV1AS*										1					1
CSO	BORE	Soil	SHB-93-22C	BXSH22XX	DV1AS*															1
SOIL/ SEDIMENT SAMPLE SUBTOTAL									32	65	166	74	166	0	173	0	0	17	162	174
Trip Blanks									4	0	0	0	0	0	0	0	0	0	0	0
Duplicates @ 5%								8	2	3	8	4	8	0	8	0	0	0	0	0
MS/MSD Samples @ 5%							8		0	0	0	4	8	0	0	0	0	0	0	0
Rinsate Blanks @ 5%									2	3	8	4	8	0	0	0	0	0	0	0
TOTAL SOIL/ SEDIMENT SAMPLES									40	71	182	86	190	0	181	0	0	17	162	174

NOTES

1. All samples will be unfiltered except samples for dissolved metals which will be field filtered.
2. TCLP metals analysis will be conducted on ten percent of pond sediment samples.
3. Matrix Spike/Matrix Spike Duplicate samples will be collected for all GC/MS analyses that do not include surrogates as part of the methodology, and for ICP, GFAA, and CVAA inorganics analysis.
   Surrogates are included in VOC, SVOC, and Pesticide/PCB methods,but not the method for explosives.
4. The collection of all groundwater and surface water samples will be accompanied by on-site measurenent of pH, specific conductance, and temperature.
   The depth to static groundwater will be measured at each monitoring well.
5. PAL = Project Analyte List

TABLE 3
FISH TISSUE SAMPLING SUMMARY

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

SPECIES	WHOLE FISH	FILLET	DUPLICATE	MATRIX SPIKE
Plow Shop Pond				
Micropterus salmoides	5	5	1	1
Ictalurus spp.	5	5	0	0
Lepomis macrochirus	5	0	0	0
Cold Spring Brook Pond				
Esox niger	3	3	1	1
Ictalurus natalis	3	3	0	0
Lepomis gibbosus	3	0	0	0

TABLE 4
REPORTING LIMITS FOR FISH TISSUE ANALYSIS

FORT DEVENS DATA GAP ACTIVITIES, GROUP 1A
FORT DEVENS, MASSACHUSETTS

ANALYTE	QUANTITATION LIMIT (µg/kg)	ANALYTE	DETECTION LIMIT (mg/kg)
alpha-BHC	5	Aluminum	1.3
beta-BHC	5	Arsenic	0.04
delta-BHC	5	Beryllium	0.04
gamma-BHC	5	Cadmium	0.07
Heptachlor	5	Copper	0.04
Aldrin	5	Chromium	0.20
Heptachlor epoxide	5	Iron	0.6
Endosulfan I	5	Lead	0.10
Dieldrin	10	Manganese	0.30
4,4'-DDE	10	Mercury	0.03
Endrin	10	Nickel	0.80
Endosulfan II	10	Selenium	0.10
4,4'-DDD	10	Thallium	0.10
Endosulfan sulfate	10	Vanadium	0.80
4,4'-DDT	10	Zinc	0.26
Methoxychlor	50	Barium	0.24
Endrin ketone	10	Calcium	4
Endrin aldehyde	10	Cobalt	0.10
alpha-Chlordane	5	Magnesium	5
gamma-Chlordane	5	Silver	0.20
Toxaphene	100	Sodium	6
Aroclor-1016	50	Antimony	1.1
Aroclor-1221	50		
Aroclor-1232	50		
Aroclor-1242	50		
Aroclor-1248	50		
Aroclor-1254	50		
Aroclor-1260	50		

Note:

All values are wet weight

FORT DEVENS PROJECT ANALYTE LIST

FORT DEVENS PROJECT ANALYTE LIST

Project Analyte List Inorganics

AL	ALUMINUM
SB	ANTIMONY
AS	ARSENIC
BA	BARIUM
BE	BERYLLIUM
CD	CADMIUM
CA	CALCIUM
CR	CHROMIUM
CO	COBALT
CU	COPPER
FE	IRON
PB	LEAD
MG	MAGNESIUM
MN	MANGANESE
HG	MERCURY
NI	NICKEL
K	POTASSIUM
SE	SELENIUM
AG	SILVER
NA	SODIUM
TL	THALLIUM
V	VANADIUM
ZN	ZINC

Project Analyte List Explosives

135TNB	1,3,5-TRINITROBENZENE
13DNB	1,3-DINITROBENZENE
246TNT	2,4,6-TRINITROTOLUENE
24DNT	2,4-DINITROTOLUENE
26DNT	2,6-DINITROTOLUENE
HMX	CYCLOTETRAMETHYLENETETRANITRAMINE
NB	NITROBENZENE
RDX	CYCLONITE
TETRYL	NITRAMINE
NG	NITROGLYCERINE
PETN	PENTAERYTHRITOL TETRANITRATE

APPENDIX A

Project Analyte List Anions/Cations

HCO3	BICARBONATE
CL	CHLORIDE
SO4	SULFATE
NO_3	NITRATE
CA	CALCIUM
K	POTASSIUM
MG	MAGNESIUM

Project Analyte List Water Quality Parameters

CL	CHLORIDES
N2KJEL	TOTAL NITROGEN
NIT	NO_3-N
SO4	SULFATES
TPO4	TOTAL PHOSPHORUS
--	HARDNESS
ALK	ALKALINITY
TSS	TOTAL SUSPENDED SOLIDS
DO	DISSOLVED OXYGEN
	COLIFORM

Project Analyte List Organics

Volatile Organic Compounds:

111TCE	1,1,1-TRICHLOROETHANE
112TCE	1,1,2-TRICHLOROETHANE
11DCE	1,1-DICHLOROETHYLENE / 1,1-DICHLOROETHENE
11DCLE	1,1-DICHLOROETHANE
12DCE	1,2-DICHLOROETHYLENES, TOTAL (CIS AND TRANS ISOMERS)
12DCLE	1,2-DICHLOROETHANE
12DCLP	1,2-DICHLOROPROPANE
ACET	ACETONE
BRDCLM	BROMODICHLOROMETHANE
C2AVE	ACETIC ACID, VINYL ETHER/VINYL ACETATE
C2H3CL	CHLOROETHENE / VINYL CHLORIDE
C2H5CL	CHLOROETHANE
C6H6	BENZENE
CCL4	CARBON TETRACHLORIDE
CH2CL2	METHYLENE CHLORIDE
CH3BR	BROMOMETHANE
CH3CL	CHLOROMETHANE

CHBR3	BROMOFORM
C13DCP	CIS-1,3-DICHLOROPROPYLENE C+S-1,3-DICHLOROPROPENE
CHCL3	CHLOROFORM
CL2CH2	DICHLOROMETHANE
CLC6H5	CHLOROBENZENE
CS2	CARBON DISULFIDE
DBRCLM	DIBROMOCHLOROMETHANE
ETC6H5	ETHYLBENZENE
MEC6H5	TOLUENE
MEK	METHYLETHYL KETONE / 2-BUTANONE
MIBK	METHYLISOBUTYL KETONE
MNBK	METHYL-N-BUTYL KETONE / 2-HEXANONE
STYR	STYRENE
T13DCP	TRANS-1,3-DICHLOROPROPENE
TCLEA	1,1,2,2-TETRACHLOROETHANE
TCLEE	TETRACHLOROETHYLENE / TETRACHLOROETHENE
TRCLE	TRICHLOROETHYLENE / TRICHLOROETHENE
TXYLEN	XYLENES, TOTAL COMBINED

Project Analyte List Organics

Semivolatile Compounds:

124TCB	1,2,4-TRICHLOROBENZENE
12DCLB	1,2-DICHLOROBENZENE
13DCLB	1,3-DICHLOROBENZENE
14DCLB	1,4-DICHLOROBENZENE
245TCP	2,4,5-TRICHLOROPHENOL
246TCP	2,4,6-TRICHLOROPHENOL
24DCLP	2,4-DICHLOROPHENOL
24DMPN	2,4-DIMETHYLPHENOL
24DNP	2,4-DINITROPHENOL
24DNT	2,4-DINITROTOLUENE
26DNT	2,6-DINITROTOLUENE
2CLP	2-CHLOROPHENOL
2CNAP	2-CHLORONAPHTHALENE
2MNAP	2-METHYLNAPHTHALENE
2MP	2-METHYLPHENOL / 2-CRESOL
2NANIL	2-NITROANILINE
2NP	2-NITROPHENOL
33DCBD	3,3'-DICHLOROBENZIDINE
3NANIL	3-NITROANILINE

46DN2C	4,6-DINITRO-2-CRESOL / METHYL-4,6-DINITROPHENOL
4BRPPE	4-BROMOPHENYLPHENYL ETHER
4CANIL	4-CHLOROANILINE
4CL3C	4-CHLORO-3-CRESOL / 3-METHYL-4-CHLOROPHENOL
4CLPPE	4-CHLOROPHENYLPHENYL ETHER
4MP	4-METHYLPHENOL / 4-CRESOL
4NANIL	4-NITROANILINE
4NP	4-NITROPHENOL
ANAPNE	ACENAPHTHENE
ANAPYL	ACENAPHTHYLENE
ANTRC	ANTHRACENE
B2CEXM	BIS (2-CHLOROETHOXY) METHANE
B2CIPE	BIS (2-CHLOROISOPROPYL) ETHER
B2CLEE	BIS (2-CHLOROETHYL) ETHER/2,2´-OXYBIS(1-OHLOROPROPANE)
B2EHP	BIS (2-ETHYLHEXYL) PHTHALATE
BAANTR	BENZO [A] ANTHRACENE
BAPYR	BENZO [A] PYRENE
BBFANT	BENZO [B] FLUORANTHENE
BBZP	BUTYLBENZYL PHTHALATE
BGHIPY	BENZO [G,H,I] PERYLENE
BKFANT	BENZO [K] FLUORANTHENE
BZALC	BENZYL ALCOHOL
CARBAZ	CARBAZOLE
CHRY	CHRYSENE
CL6BZ	HEXACHLOROBENZENE
CL6CP	HEXACHLOROCYCLOPENTADIENE
CL6ET	HEXACHLOROETHANE
DBAHA	DIBENZ [A,H] ANTHRACENE
DBZFUR	DIBENZOFURAN
DEP	DIETHYL PHTHALATE
DMP	DIMETHYL PHTHALATE
DNBP	DI-N-BUTYL PHTHALATE
DNOP	DI-N-OCTYL PHTHALATE
FANT	FLUORANTHENE
FLRENE	FLUORENE
HCBD	HEXACHLOROBUTADIENE
ICDPYR	INDENO [1,2,3-C,D] PYRENE
ISOPHR	ISOPHORONE
NAP	NAPHTHALENE
NB	NITROBENZENE
NNDNPA	N-NITROSO DI-N-PROPYLAMINE
NNDPA	N-NITROSO DIPHENYLAMINE
PCP	PENTACHLOROPHENOL
PHANTR	PHENANTHRENE

PHENOL	PHENOL
PYR	PYRENE

Project Analyte List Organics

Pesticides and PCBs:

ABHC	ALPHA-BENZENEHEXACHLORIDE / ALPHA-HEXACHLOROCYCLOHEXANE
ACLDAN	ALPHA CHLORDANE
AENSLF	ALPHA-ENDOSULFAN / ENDOSULFAN I
ALDRN	ALDRIN
BBHC	BETA-BENZENEHEXACHLORIDE / BETA-HEXACHLOROCYCLOHEXANE
BENSLF	BETA-ENDOSULFAN / ENDOSULFAN II
DBHC	DELTA-BENZENEHEXACHLORIDE / DELTA-HEXACHLOROCYCLOHEXANE
DLDRN	DIELDRIN
ENDRN	ENDRIN
ENDRNA	ENDRIN ALDEHYDE
ENDRNK	ENDRIN KETONE
ESFSO4	ENDOSULFAN SULFATE
GCLDAN	GAMMA-CHLORDANE
HPCL	HEPTACHLOR
HPCLE	HEPTACHLOR EPOXIDE
LIN	LINDANE / GAMA-BENZENEHEXACHLORIDE / GAMMA-HEXACHLOROCYCLOHEXANE
MEXCLR	METHOXYCHLOR
PCB016	PCB 1016
PCB221	PCB 1221
PCB232	PCB 1232
PCB242	PCB 1242
PCB248	PCB 1248
PCB254	PCB 1254
PCB260	PCB 1260
PPDDD	2,2-BIS (PARA-CHLOROPHENYL)-1,1-DICHLOROETHANE
PPDDE	2,2-BIS (PARA-CHLOROPHENYL)-1,1-DICHLOROETHENE
PPDDT	2,2-BIS (PARA-CHLOROPHENYL)-1,1,1-TRICHLOROETHANE
TXPHEN	TOXAPHENE

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